Heating and Ventilating

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

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Summer Cooling for Comfort as Affected by Solar Radiation

By G. A. HENDRICKSON†
and J. H. WALKER‡

THE effect of solar radiation on the amount of heat absorbed or lost by a building is ordinarily neglected in computing capacity required in a projected heating system. This is quite permissible in heating work since the absorption of radiant energy on sunshiny days means only a slightly reduced load on the heating system, while on cloudy days it is zero. The advent of cooling by refrigeration as an adjunct to summer air conditioning necessitates a closer analysis, for radiant solar energy, absorbed by the building, constitutes a much greater proportion of the summer cooling load than of the winter heating load. Moreover, heat absorbed from this source *adds to* the ordinary cooling requirements and increases the maximum capacity of the equipment required, whereas it does not affect the maximum capacity for which the heating system must be designed.

The total amount of radiant energy falling on any building during the day may be considerable, and much care should be used to reduce the fraction actually absorbed to the smallest possible value. The absorption varies greatly with the condition and material of the absorbing surface, rooms with a high ratio of wall and roof surface to cubic contents being at a particular disadvantage. The radiation through unshaded windows is a particularly serious item.

†Engineer, The Detroit Edison Company.
‡Superintendent of Central Heating, The Detroit Edison Company.

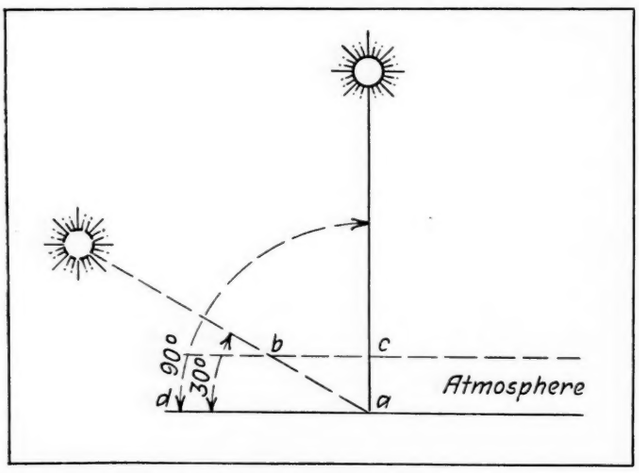


Fig. 1. Relation of solar altitude to air traversed. ab = ac Cosec. ∠ bad. Curvature of surface neglected.

Factors Influencing Intensity of Sun Radiation

The energy passing a unit area perpendicular to the direction of the sun's rays, if measured at a point outside the earth's atmosphere and at a fixed distance from the sun, is very nearly constant, varying about ± 1.5% under the influence of solar storms and other solar conditions not accurately predictable. The amount passing unit area within the earth's atmosphere depends on a great many things and varies greatly, especially with atmospheric changes. However, since maximum values are of particular interest, consideration need be given only to clear dry days.

Because of atmospheric absorption of energy before it reaches the surface of the earth, the energy intensity received is dependent on the amount of atmosphere traversed and, hence, on the altitude of the sun and the elevation of the observer. For example, the amount of atmosphere traversed with the sun at altitude 90° is just one-half that with altitude 30° (see Fig. 1).

Data on this point are shown in Fig. 2. These data were observed from the top of the south tower of the Union Guardian Building in Detroit, September 11, 1931, with an Abbot silver disk pyrheliometer calibrated by the Bureau of Standards.* Similar data in a slightly different form are given in Table VI for a few

*See "Field Studies of Office Building Cooling," by J. H. Walker, S. S. Sanford, and E. P. Wells, A.S.H.V.E. Journal, February, 1932, pp. 125-137.

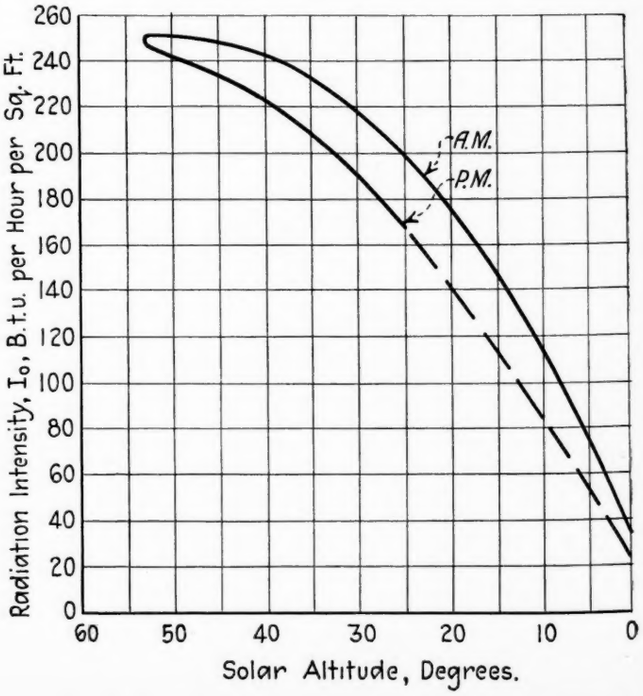


Fig. 2. Solar radiation observations at Detroit on a clear day, September 11, 1931. Individual observations showed deviations of ± 0.5% from the smooth curve given.

other locations. It should be noted that a distinct difference is noticeable between a.m. and p.m. intensities for the same solar altitude, intensities being much lower during the later hours of the day. The formation of ozone in the upper atmosphere and the vaporization of moisture into the lower atmosphere, both of which decrease atmospheric transmission, offer an explanation of this difference. In industrial districts the dust and smoke content of the air in different directions from the point of observation may be an important factor, as was probably the case in the Detroit tests. The distance of the sun at different periods of the year varies about 3.3% and, hence, the energy intensity shows a corresponding variation of 6.7%, other things being equal.

Since it is desired to know the amount of energy falling on a given surface and not on a surface perpendicular to the direction of the sun's rays, the orientation of the plane involved becomes an important factor. The calculation of the angle of incidence of the sun's rays at any given point is quite involved and it is the primary purpose of this article to present tables by means of which the true radiation effect can be quickly figured.

Calculation of Radiation Intensity

The intensity of solar energy passing a given plane may be expressed as

$$I = KI_o$$

where I = intensity, B.t.u. per hr. per sq. ft. of area in the absorbing plane.

I_o = intensity, B.t.u. per hr. per sq. ft. of area in a plane perpendicular to the direction of the sun's rays.

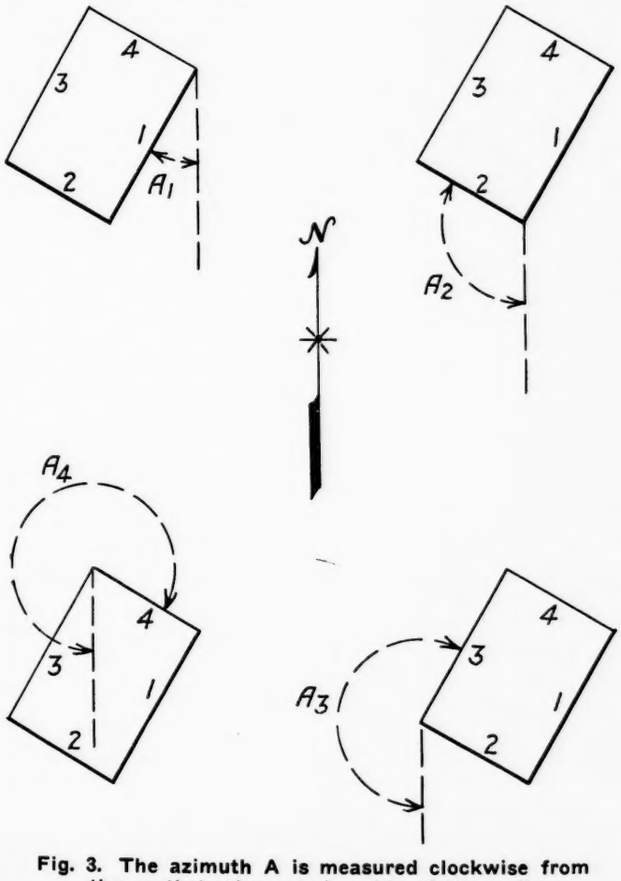


Fig. 3. The azimuth A is measured clockwise from the south to the exterior side of the wall.

Table A

Latitude and Longitude of Principal Cities in the United States

	Longitude	Latitude
Atlanta	84° 20′	33° 45′
Baltimore	76° 40′	39° 15′
Boston	71° 5′	42° 25′
Buffalo	78° 50′	42° 50′
Chicago	87° 40′	41° 45′
Cincinnati	84° 30′	39° 10′
Cleveland	81° 45′	41° 30′
Dallas	96° 45′	32° 45′
Denver	105°	39° 45′
Detroit	83° 5′	42° 20′
Indianapolis	86° 10′	39° 45′
Los Angeles	118° 15′	34°
Louisville	85° 45′	38° 15′
Memphis	90°	35° 10′
Miami	80° 15′	25° 45′
Milwaukee	88°	43°
Minneapolis	93° 15′	45°
New Orleans	90°	30°
New York	74°	40° 45′
Philadelphia	75° 5′	40°
Pittsburgh	80°	40° 25′
St. Louis	90° 10′	38° 40′
San Francisco	122° 30′	37° 45′
Seattle	122° 20′	47° 40′
Washington	77°	38° 50′

K = cosine of the angle between the direction of the sun's rays and a line perpendicular to the absorbing plane.

Values of I_o are best determined for each locality by pyrheliometric readings since, as previously noted, it varies greatly with local conditions. Measured outside the earth's atmosphere and at mean distance of the earth from the sun, I_o would be very nearly constant at 429 B.t.u. per hr. per sq. ft. In general, then,

$$I_o = 429a$$

where *a*, the coefficient of atmospheric transmission, varies between 0.6 and 0.9 for different stations within the borders of the United States with the sun in the meridian. Some data on I_o are given in Table VI. Information on the variation of *a* is available in Bulletin 79 of the National Research Council, pages 37-44. The foregoing expression for I_o is an average value and applies for the earth at mean distance from the sun.

Tables I-IV, inclusive, give values of K for vertical planes (walls and windows) at 0°, 15°, 30°, 45° and 60° North or South latitude and for each hour of the day that the sun shines. Table V gives values of K for horizontal planes (flat roofs).

These five tables permit a fairly accurate determination of the amount of energy falling on a given plane when I_o is known. Unfortunately, it is not an easy matter, except in a few simple cases, to pass from this information to a determination of the amounts of this energy that are reflected, absorbed, reradiated, lost to the surroundings by conduction, and transmitted through the material of the plane on which they fall. Fortunately, however, the simplest case is the one of most importance in the determination of summer cooling loads, namely, the transmission of solar energy through window glass. In this case about 85% to 93% (depending on the thickness and cleanliness of the glass) of the heat striking the area is transmitted through ordinary clear glass.

Fig. 4. Chronological determination of tables in which K values for different seasons of the year are found.

Month		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Day			7	8	3	2			10	11	5	3	
Table Nº for Vertical Planes	North Lat.			I	II	III			II	I			
	South Lat.	III	II	I						I	II	III	
Section of Table V for Horizontal Planes	North Lat.	4	2	1	3	5			3	1	2	4	
	South Lat.	5	3	1	2	4			2	1	3	5	

Table I

Values of K for Vertical Planes

Mar. 8 to Apr. 3 and Sept. 11 to Oct. 5 for either North or South latitudes

	Local Time A.M. →	P.M. →	Azimuth scales for values of K in light-face type. 0	15	30	45	60	75	90	105	120	135	150	165	180
	↓		180	165	150	135	120	105	90	75	60	45	30	15	0
Latitude 0°	6	6	1.000	0.966	0.866	0.707	0.500	0.259	0.000	0.259	0.500	0.707	0.866	0.966	1.000
	7	5	.966	.933	.837	.683	.483	.250	.000	.250	.483	.683	.837	.933	.966
	8	4	.866	.837	.750	.612	.433	.224	.000	.224	.433	.612	.750	.837	.866
	9	3	.707	.683	.612	.500	.354	.183	.000	.183	.354	.500	.612	.683	.707
	10	2	.500	.483	.433	.354	.250	.129	.000	.129	.250	.354	.433	.483	.500
	11	1	.259	.250	.224	.183	.129	.067	.000	.067	.129	.183	.224	.250	.259
	12		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Latitude 15°	6	6	1.000	0.966	0.866	0.707	0.500	0.259	0.000	0.259	0.500	0.707	0.866	0.966	1.000
	7	5	.966	.950	.870	.730	.541	.315	.065	.185	.425	.636	.803	.916	.966
	8	4	.866	.870	.815	.704	.545	.349	.129	.099	.321	.521	.685	.803	.866
	9	3	.707	.730	.704	.629	.512	.360	.183	.006	.195	.371	.521	.636	.707
	10	2	.500	.541	.545	.512	.444	.346	.224	.087	.056	.195	.321	.425	.500
	11	1	.259	.315	.349	.360	.346	.309	.250	.175	.087	.006	.099	.185	.259
	12		.000	.065	.129	.183	.224	.250	.259	.250	.224	.183	.129	.065	.000
Latitude 30°	6	6	1.000	0.966	0.866	0.707	0.500	0.259	0.000	0.259	0.500	0.707	0.866	0.966	1.000
	7	5	.966	.967	.901	.775	.595	.375	.129	.125	.371	.592	.772	.900	.966
	8	4	.866	.901	.875	.789	.650	.466	.250	.017	.217	.436	.625	.772	.866
	9	3	.707	.775	.789	.750	.660	.525	.354	.159	.047	.250	.436	.592	.707
	10	2	.500	.595	.650	.660	.625	.548	.433	.289	.125	.047	.217	.371	.500
	11	1	.259	.375	.466	.525	.548	.536	.483	.400	.289	.159	.017	.125	.259
	12		.000	.129	.250	.354	.433	.483	.500	.483	.433	.354	.250	.129	.000
Latitude 45°	6	6	1.000	0.966	0.866	0.707	0.500	0.259	0.000	0.259	0.500	0.707	0.866	0.966	1.000
	7	5	.966	.980	.928	.812	.642	.427	.183	.073	.325	.554	.745	.886	.966
	8	4	.866	.928	.927	.862	.739	.566	.354	.117	.127	.362	.573	.745	.866
	9	3	.707	.812	.862	.854	.787	.666	.500	.300	.080	.146	.362	.554	.707
	10	2	.500	.642	.739	.787	.780	.721	.612	.462	.280	.080	.127	.325	.500
	11	1	.259	.427	.566	.666	.721	.727	.683	.593	.462	.300	.117	.073	.259
	12		.000	.183	.354	.500	.612	.683	.707	.683	.612	.500	.354	.183	.000
Latitude 60°	6	6	1.000	0.966	0.866	0.707	0.500	0.259	0.000	0.259	0.500	0.707	0.866	0.966	1.000
	7	5	.966	.991	.949	.842	.677	.467	.224	.034	.289	.525	.724	.875	.966
	8	4	.866	.949	.967	.919	.808	.642	.433	.194	.058	.306	.534	.724	.866
	9	3	.707	.842	.919	.933	.884	.775	.612	.409	.177	.067	.306	.525	.707
	10	2	.500	.677	.808	.884	.900	.854	.750	.595	.400	.177	.058	.289	.500
	11	1	.259	.467	.642	.775	.854	.875	.837	.741	.595	.409	.194	.034	.259
	↑ 12	↑	.000	.224	.433	.612	.750	.837	.866	.837	.750	.612	.433	.224	.000
		P.M. →	360	345	330	315	300	285	270	255	240	225	210	195	180
	A.M. →		180	195	210	225	240	255	270	285	300	315	330	345	360
	Time		Azimuth scales for values of K in bold-face type.												

The problem of determining the heat flow through walls has been treated at great length in the Journal of the American Society of Heating and Ventilating Engineers[1]. Often, the transmission through the walls may be neglected in computing cooling loads. It becomes important, however, in cases of high outside air temperatures or in cases where wall transmission constitutes the principal source of heat gain, as in a storage house.

It is of interest to note how the disposition of exterior exposure affects the variation in cooling loads. Rooms with a large eastern exposure will have a very pronounced daily maximum during the morning hours, whereas a large expanse of horizontal roof with skylights or a large western exposure give maxima at noon or in the afternoon, respectively. There is also a seasonal variation of these maxima. Buildings having a relatively large wall area as compared to the roof area

[1]See "Heat Transmission as Influenced by Heat Capacity and Solar Radiation," by F. C. Houghten, J. L. Blackshaw, E. M. Pugh, and Paul McDermott, A.S.H.V.E. Journal, April, 1932, pp. 288-310.

Table II
Values of K for Vertical Planes

Apr. 3 to May 2 and Aug. 10 to Sept. 11 for locations in North latitudes
Feb. 7 to Mar. 8 and Oct. 5 to Nov. 3 for locations in South latitudes.

	Local Time A.M. →	Local Time P.M. →	Azimuth scales for values of K in light-face type. 0	15	30	45	60	75	90	105	120	135	150	165	180
			P.M. → 180	165	150	135	120	105	90	75	60	45	30	15	0
Latitude 0°	5	7	0.951	0.874	0.737	0.550	0.325	0.078	0.174	0.414	0.626	0.795	0.911	0.964	0.951
	6	6 *	.985	.906	.766	.574	.342	.085	.174	.423	.643	.819	.940	.996	.985
	7	5	.951	.874	.737	.550	.325	.078	.174	.414	.626	.795	.911	.964	.951
	8	4	.853	.779	.652	.480	.276	.053	.174	.388	.577	.726	.825	.869	.853
	9	3	.696	.628	.516	.370	.198	.012	.174	.348	.499	.615	.690	.718	.696
	10	2	.492	.431	.340	.225	.096	.040	.174	.295	.397	.471	.513	.521	.492
	11	1	.255	.201	.154	.057	.023	.102	.174	.234	.278	.303	.308	.291	.255
		12	.000	.045	.087	.123	.150	.168	.174	.168	.150	.123	.087	.045	.000
Latitude 15°	5	7	0.951	0.858	0.707	0.507	0.273	0.020	0.231	0.472	0.678	0.838	0.941	0.979	0.951
	6	6 *	.985	.908	.769	.578	.347	.093	.168	.417	.638	.815	.937	.995	.985
	7	5	.951	.893	.773	.601	.388	.148	.104	.345	.564	.745	.875	.945	.951
	8	4	.853	.813	.718	.575	.392	.182	.040	.260	.461	.632	.759	.834	.853
	9	3	.696	.676	.609	.501	.359	.192	.012	.168	.337	.484	.597	.669	.696
	10	2	.492	.489	.453	.386	.292	.179	.053	.076	.200	.311	.400	.462	.492
	11	1	.255	.267	.260	.236	.195	.142	.078	.010	.059	.125	.181	.226	.255
		12	.000	.020	.044	.062	.075	.084	.087	.084	.075	.062	.044	.020	.000
Latitude 30°	5	7	0.951	0.847	0.685	0.476	0.235	0.022	0.278	0.515	0.716	0.869	0.963	0.991	0.951
	6	6 *	.985	.912	.778	.590	.362	.110	.150	.400	.623	.803	.928	.990	.985
	7	5	.951	.913	.812	.656	.456	.224	.023	.268	.496	.689	.835	.925	.951
	8	4	.853	.849	.787	.671	.509	.313	.096	.128	.343	.535	.691	.799	.853
	9	3	.696	.724	.702	.632	.519	.371	.198	.011	.177	.353	.504	.621	.696
	10	2	.492	.547	.564	.543	.485	.394	.276	.139	.007	.153	.288	.404	.492
	11	1	.255	.330	.383	.410	.409	.382	.325	.248	.154	.050	.058	.162	.255
		12	.000	.089	.171	.242	.296	.330	.342	.330	.296	.242	.171	.089	.000
Latitude 45°	5	7	0.951	0.840	0.672	0.458	0.213	0.047	0.303	0.539	0.738	0.887	0.975	0.997	0.951
	6	6 *	.985	.919	.791	.610	.386	.136	.123	.373	.599	.783	.914	.983	.985
	7	5	.951	.934	.853	.713	.525	.302	.057	.191	.426	.632	.795	.904	.951
	8	4	.853	.882	.851	.762	.622	.439	.225	.003	.231	.444	.626	.765	.853
	9	3	.696	.768	.788	.754	.668	.537	.370	.177	.028	.231	.418	.577	.696
	10	2	.492	.600	.667	.688	.662	.591	.480	.336	.170	.009	.186	.351	.492
	11	1	.255	.389	.496	.569	.604	.597	.550	.465	.349	.209	.054	.104	.255
		12	.000	.148	.287	.406	.497	.554	.574	.554	.497	.406	.287	.148	.000
Latitude 60°	4	8	0.853	0.691	0.482	0.240	0.018	0.275	0.513	0.717	0.871	0.966	0.995	0.957	0.853
	5	7 *	0.951	.839	.670	.455	.209	.051	.308	.543	.742	.890	.978	.998	.951
	6	6	.985	.929	.809	.635	.417	.171	.087	.339	.568	.758	.896	.974	.985
	7	5	.951	.953	.891	.767	.592	.376	.134	.117	.360	.578	.757	.884	.951
	8	4	.853	.912	.908	.843	.721	.549	.340	.107	.132	.363	.569	.736	.853
	9	3	.696	.806	.861	.857	.795	.679	.516	.318	.099	.127	.345	.539	.696
	10	2	.492	.644	.752	.809	.811	.757	.652	.502	.318	.113	.101	.307	.492
	11	1	.255	.437	.589	.701	.766	.778	.737	.646	.511	.341	.148	.055	.255
	↑	12 ↑	.000	.198	.383	.542	.663	.740	.766	.740	.663	.542	.383	.198	.000
		P.M. →	360	345	330	315	300	285	270	255	240	225	210	195	180
	A.M. →	Time	180	195	210	225	240	255	270	285	300	315	330	345	360

Azimuth scales for values of K in bold-face type.

*Note: Sunset and sunrise in these intervals.

will normally have their maximum daily maxima in late summer when the sun is low, while low flat buildings with a relatively large roof area will experience their greatest daily maxima in early summer (June in northern latitudes, December in southern) when the sun reaches its maximum altitudes.

The values of K given take no account of the diffuse radiant energy from a clear illuminated sky. This item is about 10% to 15% as great as the maximum value of direct solar radiation (measured in a direction perpendicular to the sun's rays) for horizontal planes and about 5% or 6% for vertical planes. If a portion of the sky is shaded from the surface considered, these percentages would be correspondingly reduced.

Table III

Values of K for Vertical Planes

May 2 to Aug. 10 for locations in North latitudes
Nov. 3 to Feb. 7 for locations in South latitudes

	Local Time A.M. →	P.M. →		Azimuth scales for values of K in light-face type.												
				0	15	30	45	60	75	90	105	120	135	150	165	180
	↓	↓		180	165	150	135	120	105	90	75	60	45	30	15	0
Latitude 0°	5	7		0.908	0.788	0.615	0.400	0.158	0.095	0.342	0.565	0.750	0.884	0.957	0.965	0.908
	6	6	*	.940	.819	.643	.423	.174	.087	.342	.574	.766	.906	.985	.996	.940
	7	5		.908	.788	.615	.400	.158	.095	.342	.565	.750	.884	.957	.965	.908
	8	4		.814	.698	.534	.334	.111	.120	.342	.541	.703	.817	.876	.875	.814
	9	3		.664	.553	.404	.228	.036	.158	.342	.502	.628	.712	.746	.730	.664
	10	2		.470	.365	.236	.090	.061	.209	.342	.452	.531	.574	.578	.542	.470
	11	1		.243	.146	.040	.070	.175	.267	.342	.393	.418	.414	.382	.323	.243
		12		.000	.089	.171	.242	.296	.330	.342	.330	.296	.242	.171	.089	.000
Latitude 15°	5	7		0.908	0.775	0.589	0.364	0.113	0.145	0.391	0.615	0.794	0.920	0.983	0.979	0.908
	6	6	*	.940	.822	.649	.431	.184	.076	.330	.562	.756	.898	.979	.993	.940
	7	5		.908	.808	.652	.453	.222	.023	.270	.493	.685	.831	.920	.946	.908
	8	4		.814	.732	.600	.428	.226	.009	.209	.412	.588	.723	.809	.840	.814
	9	3		.664	.601	.496	.358	.195	.019	.158	.325	.469	.582	.655	.683	.664
	10	2		.470	.423	.347	.248	.131	.006	.120	.237	.339	.417	.467	.485	.470
	11	1		.243	.210	.163	.104	.039	.029	.095	.155	.204	.239	.258	.260	.243
		12		.000	.025	.044	.062	.076	.084	.087	.084	.076	.062	.044	.025	.000
Latitude 30°	5	7		0.908	0.769	0.577	0.346	0.092	0.169	0.418	0.638	0.816	0.937	0.995	0.985	0.908
	6	6	*	.940	.831	.666	.455	.213	.043	.296	.529	.726	.874	.962	.984	.940
	7	5		.908	.832	.699	.518	.303	.066	.175	.404	.605	.765	.873	.922	.908
	8	4		.814	.770	.674	.532	.354	.151	.061	.270	.460	.619	.735	.802	.814
	9	3		.664	.651	.593	.495	.363	.207	.036	.137	.301	.444	.557	.632	.664
	10	2		.470	.482	.462	.410	.331	.229	.111	.015	.139	.254	.352	.425	.470
	11	1		.243	.276	.289	.283	.258	.217	.158	.089	.015	.061	.132	.194	.243
		12		.000	.045	.087	.123	.150	.168	.174	.168	.150	.123	.087	.045	.000
Latitude 45°	4	8		0.814	0.637	0.418	0.170	0.090	0.344	0.574	0.765	0.904	0.981	0.992	0.935	0.814
	5	7	*	.908	.770	.579	.349	.095	.165	.414	.635	.812	.934	.993	.984	.908
	6	6		.940	.845	.693	.493	.260	.010	.242	.477	.679	.835	.935	.970	.940
	7	5		.908	.859	.751	.592	.393	.167	.070	.302	.514	.691	.821	.895	.908
	8	4		.814	.809	.750	.639	.485	.298	.090	.123	.329	.512	.660	.763	.814
	9	3		.664	.701	.689	.631	.530	.392	.228	.048	.135	.309	.461	.583	.664
	10	2		.470	.540	.574	.568	.524	.444	.334	.201	.054	.096	.240	.368	.470
	11	1		.243	.338	.411	.455	.468	.449	.400	.323	.225	.111	.011	.131	.243
		12		.000	.109	.211	.299	.366	.408	.423	.408	.366	.299	.211	.109	.000
Latitude 60°	3	9		0.664	0.449	0.202	0.058	0.314	0.549	0.746	0.893	0.979	0.998	0.949	0.835	0.664
	4	8	*	.814	.636	.416	.167	.094	.348	.578	.769	.907	.984	.994	.936	.814
	5	7		.908	.778	.595	.372	.123	.134	.382	.604	.784	.912	.977	.975	.908
	6	6		.940	.863	.728	.544	.322	.078	.171	.408	.618	.785	.899	.952	.940
	7	5		.908	.887	.806	.670	.488	.273	.040	.197	.419	.614	.766	.866	.908
	8	4		.814	.847	.823	.742	.611	.438	.236	.017	.203	.409	.587	.725	.814
	9	3		.664	.746	.778	.756	.682	.563	.404	.219	.018	.184	.373	.537	.664
	10	2		.470	.592	.674	.710	.697	.637	.534	.394	.227	.045	.140	.316	.470
	11	1		.243	.394	.518	.607	.654	.657	.615	.531	.411	.263	.097	.076	.243
	↑	12	↑	.000	.166	.321	.455	.557	.621	.643	.621	.557	.455	.321	.166	.000
		P.M. →		360	345	330	315	300	285	270	255	240	225	210	195	180
	A.M. →			180	195	210	225	240	255	270	285	300	315	330	345	360
	Time			Azimuth scales for values of K in bold-face type.												

*Note: Sunrise and sunset in these intervals.

Table IV

Values of K for Vertical Planes

Feb. 7 to Mar. 8 and Oct. 5 to Nov. 3 for locations in North latitudes.
Apr. 3 to May 2 and Aug. 10 to Sept. 11 for locations in South latitudes.

Azimuth scales for values of K in light-face type.

Local Time A.M. →		0	15	30	45	60	75	90	105	120	135	150	165	180
P.M. →		180	165	150	135	120	105	90	75	60	45	30	15	0
6	6	0.985	0.995	0.937	0.815	0.638	0.417	0.168	0.093	0.347	0.578	0.769	0.908	0.985
7	5	* .951	.979	.941	.838	.678	.472	.231	.020	.273	.507	.707	.858	.951
8	4	.853	.900	.886	.812	.682	.506	.295	.064	.171	.394	.591	.747	.853
9	3	.696	.763	.777	.738	.649	.516	.348	.156	.047	.246	.429	.583	.696
10	2	.492	.576	.621	.623	.583	.503	.388	.248	.090	.074	.232	.375	.492
11	1	.255	.353	.428	.473	.486	.466	.414	.334	.231	.112	.014	.139	.255
12	12	.000	.107	.211	.299	.366	.408	.423	.408	.366	.299	.211	.107	.000
P.M. →		360	345	330	315	300	285	270	255	240	225	210	195	180
A.M. →		180	195	210	225	240	255	270	285	300	315	330	345	360
Time														

Latitude 15°

Azimuth scales for values of K in bold-face type.

*Note: Sunrise and sunset in these intervals.

Table V†

Values of K for Horizontal Planes

Local Time A.M.	P.M.		Latitude 0	5	10	15	20	25	30	35	40	45	50	55	60
6	6		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	5		.259	.258	.255	.250	.243	.235	.224	.212	.198	.183	.166	.148	.129
8	4	Section 1	.500	.498	.492	.483	.470	.453	.433	.410	.383	.354	.321	.287	.250
9	3		.707	.704	.696	.683	.664	.641	.612	.579	.542	.500	.455	.406	.354
10	2		.866	.863	.853	.837	.814	.785	.750	.709	.663	.612	.557	.497	.433
11	1		.966	.962	.951	.933	.908	.875	.837	.791	.740	.683	.621	.554	.483
12	12		1.000	.996	.985	.966	.940	.906	.866	.819	.766	.707	.643	.574	.500
12	12		0.985	0.966	0.940	0.907	0.866	0.819	0.766	0.707	0.643	0.574	0.500	0.423	0.342
1	11	Section 2 (Bold-face type)	.951	.932	.907	.874	.834	.789	.737	.680	.617	.550	.478	.403	.325
2	10		.853	.834	.810	.779	.742	.700	.652	.599	.542	.480	.415	.347	.276
3	9		.696	.673	.656	.628	.595	.558	.516	.471	.422	.371	.315	.257	.198
4	8		.492	.475	.455	.431	.403	.373	.340	.304	.266	.225	.183	.140	.096
5	7		.255	.239	.221	.201	.180	.158	.134	.109	.084	.057	.031	.004	.023
6	6		.000	.015	.030	.045	.059	.073	.087	.100	.112	.123	.133	.142	.150
7	5	Section 3 (Light-face type)	.255	.269	.281	.291	.299	.304	.308	.308	.307	.303	.297	.288	.278
8	4		.492	.506	.515	.521	.522	.520	.513	.503	.489	.471	.450	.425	.397
9	3		.696	.709	.716	.718	.714	.705	.690	.670	.645	.615	.581	.542	.498
10	2		.853	.865	.870	.869	.861	.846	.825	.798	.765	.726	.681	.631	.577
11	1		.951	.963	.967	.964	.953	.935	.911	.879	.840	.795	.744	.688	.626
12	12		.985	.996	1.000	.996	.985	.966	.940	.906	.866	.819	.766	.707	.643
12	12		0.940	0.906	0.866	0.819	0.766	0.707	0.643	0.574	0.500	0.423	0.342	0.259	0.174
1	11	Section 4 (Bold-face type)	.908	.874	.834	.788	.736	.678	.615	.547	.475	.400	.321	.240	.158
2	10		.814	.781	.742	.698	.648	.593	.534	.470	.404	.334	.261	.187	.111
3	9		.664	.632	.595	.553	.507	.458	.404	.348	.289	.228	.165	.101	.036
4	8		.470	.438	.403	.365	.325	.281	.236	.189	.140	.090	.040	.011	.061
5	7		.243	.212	.180	.146	.112	.076	.040	.003	.034	.070	.106	.141	.175
6	6		.000	.030	.059	.089	.117	.145	.171	.196	.220	.242	.262	.280	.296
7	5	Section 5 (Light-face type)	.243	.272	.299	.323	.346	.365	.382	.395	.406	.414	.418	.420	.418
8	4		.470	.498	.522	.542	.558	.570	.578	.581	.580	.574	.564	.550	.531
9	3		.664	.692	.714	.730	.741	.747	.746	.740	.729	.712	.689	.661	.628
10	2		.814	.840	.861	.875	.882	.882	.876	.863	.843	.817	.785	.747	.703
11	1		.908	.934	.953	.965	.970	.967	.957	.940	.915	.884	.845	.801	.750
12	12		.940	.966	.985	.996	1.000	.996	.985	.966	.940	.906	.866	.819	.766

†*Key to sections of this table are given in Fig. 4.*

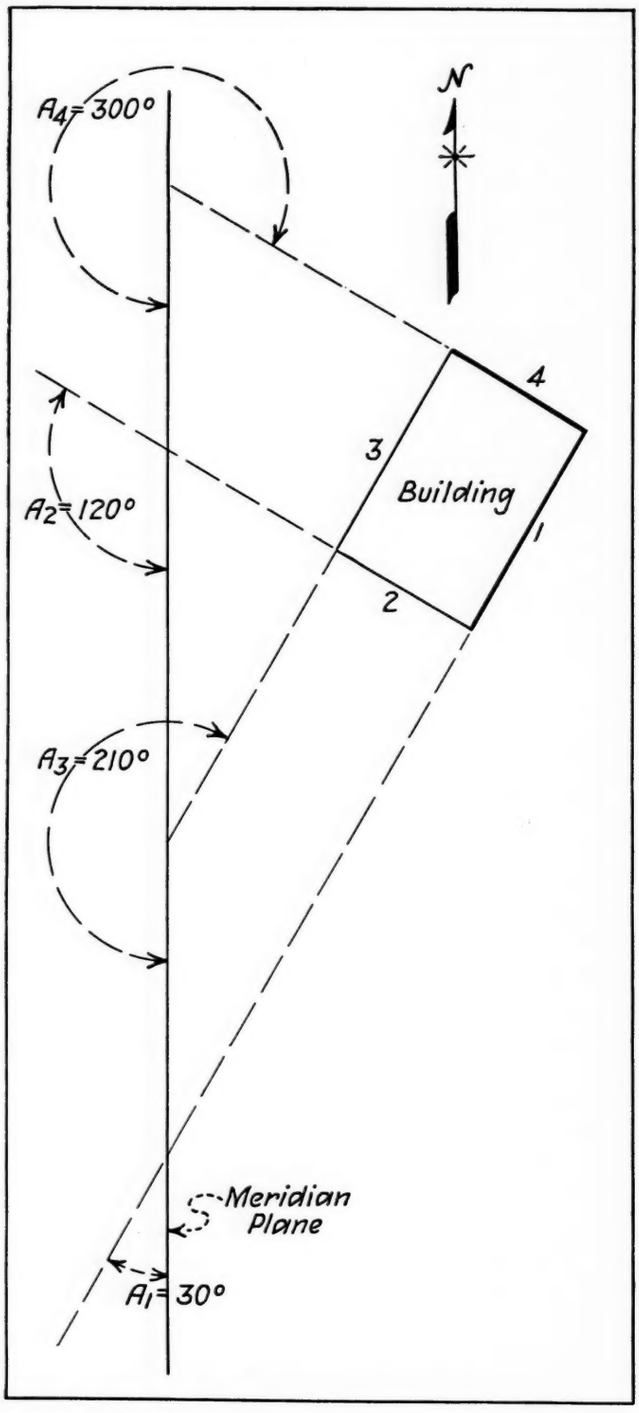


Fig. 5. Azimuths of different walls of building referred to in sample calculations. The azimuth A is always measured clockwise from the south into the exterior of the wall.

Explanation of the Tables

The *azimuth* of a wall as used in Tables I-IV, inclusive, is the angle in degrees between the exterior of the wall and a meridian plane, measured clockwise from the south. The definition is illustrated in Fig. 3.

The solar altitude of Table VI is the angular distance of the sun above the horizon measured in a vertical plane.

Fig. 4 and Table A may be used to help locate the correct table for use with different seasons of the year, and for different locations in the United States.

All tables are computed for apparent solar time and three solar positions, 0°, 10°, and 20°, from the equator.

Table VI
Solar Radiation Observations†

I_o in B.t.u. per hr. per sq. ft. averaged from intermittent readings.

Solar Altitude Washington, D. C.	May	June	July	Aug.	Sept.
11.3°	...	...	113	135	...
14.3°	139	...	135	150	142
19.3°	173	186	161	175	166
30°	221	223	195	201	192
90°	292*	277*	265*	274*	248*
30°	219*	...	...	...	301
19.3°	175	...	...	...	...
14.3°	119	...	...	...	...
11.3°	...	...	...	...	...
Madison, Wis.					
11.3°	...	...	...	...	...
14.3°	...	...	...	208	...
19 3°	...	...	...	246	243
30°	241	257	234	254	254
90°	305*	310*	292*	303*	298*
30°	...	...	...	274	259
19.3°	...	...	...	...	...
14.3°	...	...	...	...	...
11.3°	...	...	...	...	...
Lincoln, Neb.					
11.3°	...	...	...	155	...
14.3°	175	199	166	173	186
19.3°	190	225	199	203	221
30°	237	259	241	243	259
90°	301*	307*	294*	288*	314*
30°	254	269	243	243	254
19.3°	...	232	199	217	214
14.3°	...	204	168	190	184
11.3°	...	...	...	166	166

†Taken from Monthly Weather Review, 1928.
*Extrapolated.

It is intended that when the sun is within 5° of one of these positions the value of K computed for that position be used. This is the significance of Fig. 4.

Local mean solar time may be substituted for apparent solar time. The difference is never more than 16 min. and is usually much less (see "Equation of Time," Encyclopedia Britannica for data). To obtain local mean solar time from standard time:

$$t = t_s - \frac{L - L_m}{15}$$

t = local mean solar time, in hr.
t_s = standard time in hr.
L = longitude of location
L_m = longitude of meridian on which standard time is based

The standard time zones in the United States are:

Time Zone	Meridian West from Greenwich
Atlantic	60
Eastern	75
Central	90
Mountain	105
Pacific	120

Sample Computation

Suppose it is desired to know the solar energy falling on the walls and roof of a building situated as shown in Fig. 5, located at 30° north latitude and 82° 30′ longitude west from Greenwich on July 25.

This defines the problem, and to solve it proceed as follows: First, get the details of the problem clear. What we want to do is to find values of K for use in the formula $I = KI_o$, as given on page 15. To solve this problem entirely we must apply this formula to each of the four walls, and to the roof separately. As the value K changes with different hours of the day, it

will be well to find it for all daylight hours. The most convenient way to do this is by setting up a table and entering the values as we find them. Our table, therefore, will contain five columns for the K's, one each for the southeast wall, southwest wall, northwest wall, northeast wall, and one for the roof. As the tables are based on solar (or local) time, while standard time for the time zone is the one usually carried on watches, we will arrange the table with two columns for time, one for the standard time and one for the solar time.

With the table set up we can proceed with the solution. First, set down the daylight hours as standard time. With this case, the time will be eastern standard, since the location is between 75° and 90° west longitude. Apply the time equation for each hour and find the mean solar time. Enter in the mean solar (or local) time column.

With the times entered, the next step is to determine in which of the tables we will find the values of K for the walls and the roof. Fig. 4, page 16, gives the key to this. Use it as follows: Since July 25 is the day under consideration, look under the column marked July (Fig. 4) opposite North latitude and find numeral III. This indicates that value of K for walls will be found in Table III. In the same way, under July opposite North latitude we find the figure 5. This indicates that values of K for the roof will be found in section 5 of Table V. This locates the proper tables and we are ready to solve as soon as the azimuths of the building walls are determined. This is best done by actually making a drawing like Fig. 5, being careful to measure the azimuth clockwise from the south into the exterior of the wall.

We can illustrate the use of Table III by finding values of K for the southeast wall. Values for other walls are found in exactly the same way. The latitude being 30° in the example, enter Table III at the section marked latitude 30° at the left. In the first column we find that sunrise occurs between 5 a.m. and 6 a.m., and sunset between 6 p.m. and 7 p.m. local time. Our figures in the table are then at hourly intervals from 6 a.m. to 6 p.m. The azimuth of the southeast wall is 30° (from Fig. 5).

The construction of Tables I to IV is rather complicated and should be explained. It will be noted that all figures from 0° to 180° appear twice in the scale of azimuth values across the top of the table, the same being true of values from 180° to 360° at the bottom. When the azimuth scale at the top is being used, only values of K in light-face type are to be considered. If when reading into a particular square in the table and using the azimuth scale at the top there is no light-face type in that position, this indicates that K for that case is 0. Exactly the same is true when using the scale at the bottom and reading up. Here only bold-face figures are used, and if there are no bold-face figures, K is 0.

Since there are two azimuth scales at both top and bottom, arrow heads are used at the left to show the azimuth scale to be used. Thus, in all cases, for morning hours the upper azimuth scale at the top or the lower scale at the bottom of the table is the one to be used. The tables are so arranged solely to save space. Doubling the azimuth scales need not be confusing if care is taken to distinguish between the types.

For the example being considered with an azimuth of 30° the figures will be found on the upper azimuth scale at the top for morning hours, and the lower scale at the top for afternoon hours. At 6 a.m. the value of K will thus be found to be 0.666; at 7 a.m. it will be 0.699. Enter these figures in the table and continue to noon, when K is 0.087. Now passing to the afternoon, the reading at 1 p.m. we must read under 30° in the lower column on the top scale, we find .132, but this is in bold-face type. This means that the value of K is zero, and we so enter it in our table. The same is true for all afternoon hours for the southeast wall.

The northwest wall has an azimuth of 210° and must be read on the bottom azimuth scales. Proceeding in the same way as for the southeast wall, we find the columns for 210° on the bottom scales. At 6 a.m. we find the figure 0.666 in light-face type. Bearing in mind that when using azimuth scales at the bottom, light-face type indicates a K value of zero, we find that we have no values of K above zero during any of the morning hours for the northwest wall. When we change to afternoon, however, we find that at 1 p.m. we get a value of .132 in bold-face type. We enter this in the table, and continue for other afternoon hours.

These cases illustrate the use of Tables I to IV. For the roof, use Table V as follows: We have already noted that for our example section 5 of Table V is to be used. Beside section 5 we find the words (Light-face type). This means that section 5 includes all light-faced type in the lower third of the table.

In this case, for latitude 30°, read under the 30° column and begin at 6 a.m. This gives .171, and since this is light face, include it in the table. It will be noted that values of light face will be found till 6 p.m. At 7 p.m., however, we find a bold-face figure. This means that at 7 p.m., K equals zero for the roof.

When the values have all been found and entered in the table, it will appear as follows for this example:

Time		K_1	K_2	K_3	K_4	K_r
Eastern Standard	Apparent Mean Solar	S.E. Wall	S.W. Wall	N.W. Wall	N.E. Wall	Roof
6:30 a.m.	6:00 a.m.	0.666			0.726	0.171
7:30	7:00	0.699			0.605	0.382
8:30	8:00	0.674			0.460	0.578
9:30	9:00	0.593			0.301	0.746
10:30	10:00	0.462			0.139	0.876
11:30	11:00	0.289	0.015			0.957
12:30 p.m.	12:00 m.	0.087	0.150			0.985
1:30	1:00 p.m.		0.258	0.132		0.957
2:30	2:00		0.331	0.352		0.876
3:30	3:00		0.363	0.557		0.746
4:30	4:00		0.354	0.735		0.578
5:30	5:00		0.303	0.873		0.382
6:30	6:00		0.213	0.962		0.171

The values of I_o are to be found by local observation. If $I_o = 220$ B.t.u. per hr. per sq. ft. at 10:30 a.m. on July 25, then the energy falling on the southeast wall is

$$I_1 = K_1 I_o$$
$$= 0.462 \times 220$$
$$= 101.6 \text{ B.t.u. per hr. per sq. ft.}$$

on the northeast wall is

$$I_4 = K_4 I_o$$
$$= 0.132 \times 220$$
$$= 29.0 \text{ B.t.u. per hr. per sq. ft.}$$

on the roof is

$$I_r = K_r I_o$$
$$= 0.876 \times 220$$
$$= 192.7 \text{ B.t.u. per hr. per sq. ft.}$$

The southwest and northwest walls are shaded.

Condensate Recovery System Shows a Saving of $2500 per Year on a $4000 Investment

By EARL P. WELLS†

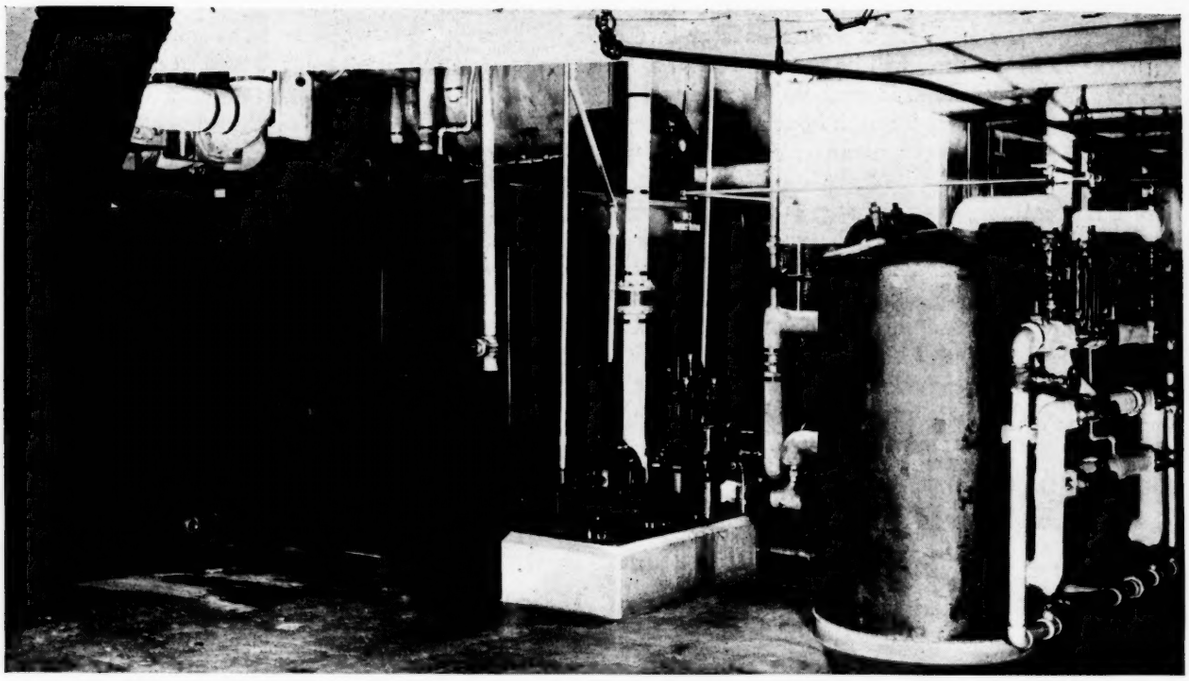


Fig. 1. Condensate recovery equipment used in Union Guardian Building, Detroit. The meter is shown above the tank. A reciprocating pump is shown in the center with the centrifugal pump behind. The two filters appear on the right.

BUILDINGS that purchase steam from district heating plants frequently discharge the condensate to the sewer, thereby wasting both the water and heat contained in it. Many buildings use economizers to extract the heat, but this method is inefficient. Economizers require a temperature difference between the condensate and water being heated, and this difference represents a large proportion of lost heat. Also, the maximum return of condensate occurs during the heating-up period in the morning, when the need for hot water is usually at a minimum.

A system which stores the condensate and injects it into the hot water system for lavatory use permits the maximum use of both the water and the heat contained in it. Such a system has been installed in the Union Guardian Building in Detroit during the past year and has proved to be successful. The system cost approximately $4000, and the savings during the first year amounted to $2500.

The general arrangement of the equipment is as follows: Condensate from three steam meters of the Detroit Edison Company discharges into a 5000-gal. storage tank in the third basement. About half of the condensate comes back at 170° from the blast heaters of the indirect heating system, and the other half at 90° to 110° from the direct heating system. The cooler portion enters the storage tank near the overflow pipe, so that it is the first to be discharged to the sewer when there is an excess.

From the outlet pipe at the bottom of the tank the condensate passes in turn through a small centrifugal pump, a gravel filter, and a reciprocating pump, and is discharged into a balancing tank on the top floor of the building, 520 ft. up. One branch on the riser at the 24th floor, and two branches in the third basement, deliver the water to the three hot water zones. The two lower branches have reducing valves which are set at slightly higher pressures than the pressures exerted by the house service tanks which supply cold water to the heaters when there is no condensate available. The balancing tank, being placed above the highest house service tank, delivers a naturally greater pressure in the upper zone. Check valves prevent condensate from flowing into the cold water supply lines.

The arrangement of piping after the change is shown in Fig. 2. The method of controlling the temperature of the water in the two lower zones was changed from the use of thermostatically-operated water mixing valves, with the steam left on continually, to the use of thermostatically-controlled steam throttling valves.

†Air Conditioning Engineer, Union Guardian Building, Detroit.

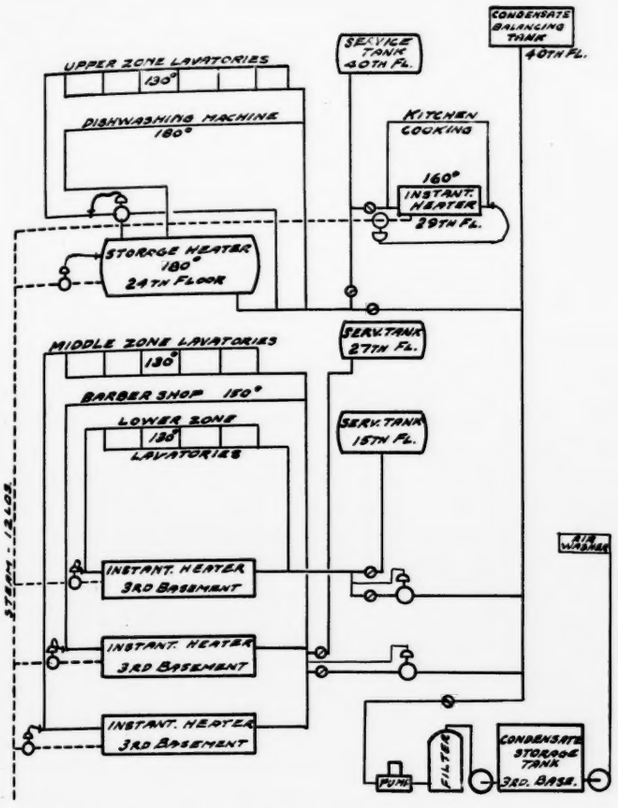


Fig. 2. Arrangement of piping for condensate recovery

This arrangement automatically keeps the circulating hot water at 130° when the entering condensate is below this temperature, or when the heat loss through the insulation, with no water being drawn, causes the temperature to drop.

Control of the condensate pumps consists primarily of a float switch in the balancing tank, which starts and stops the centrifugal and reciprocating pumps simultaneously. Another float switch in the basement storage tank prevents the pumps from starting when the tank is empty.

The purpose of the gravel filter is to remove suspended rust. Sal soda and alum are fed into the inlet pipe of the filter, causing a flow which aids in rust removal. An excess of soda is used to offset the acidity of the condensate. Considerable experimenting was done to adjust the feed so that the alkalinity, as shown by methyl orange, would be raised from three parts per million to 20, with soda, and then reduced to 15 with alum. There is some variation in the feed, but it has been found possible to prevent the formation of red water, which occurs if no treatment is used, or if an excess of alum is used. An analysis of the condensate is shown in Table 1.

TABLE 1
CHEMICAL ANALYSES
PARTS PER MILLION

	Condensate	City Water
Suspended matter	3.0	0.5
Total hardness	2.0	93.0
Alkalinity (M)	3.0	73.0
Total dissolved solids	7.0	113.0
Free carbon dioxide	2.0	4.5

While the water is comparatively pure, it has a slight, nauseating odor and taste, originating from oil, which prevents its use for drinking. A test showed that the taste and odor could successfully be removed with an activated carbon filter, rendering it fit for human consumption. However, it was decided not to use the condensate for kitchen cooking because of the possibility of improper operation of the filter on the part of the maintenance engineers. Instead, a small instantaneous heater using city water was installed for cooking purposes, leaving the dishwashers supplied with condensate.

Another centrifugal pump was added during the past winter to take condensate directly from the storage tank and deliver it to the pans of five air washers for humidification. The pump is operated continually when the outdoor temperature is below 30°, the flow to each washer being controlled thermostatically through pneumatic valves. Thus, an additional use is found for the excess of condensate which occurs below 35° outdoors, saving steam formerly used in the tempering coils.

The method by which the size of the storage tank was determined is shown in Fig. 3. Hourly readings of the steam flow and hot water use were made and graphed. It was found that the total daily hot water consumption was equal to the steam consumption (in pounds) when the outdoor temperature was about 35°. Graphing the steam flow for a 35° day, and assuming the storage tank empty before starting the heating system at 6 a.m., another graph was made of the accumulation of condensate at the end of each hour, less the hot water used during that hour. The peak of the storage graph showed that it would be necessary to store 34,850 lb. or 4180 gal. A tank 10 ft. x 12 ft. x 5 ft. 8 in. was built of ¼ in. steel plate, reinforced with channel irons and rods. It was covered with 2 in. asbestos air cell insulation and galvanized sheet iron, and was set on 2 in. cork.

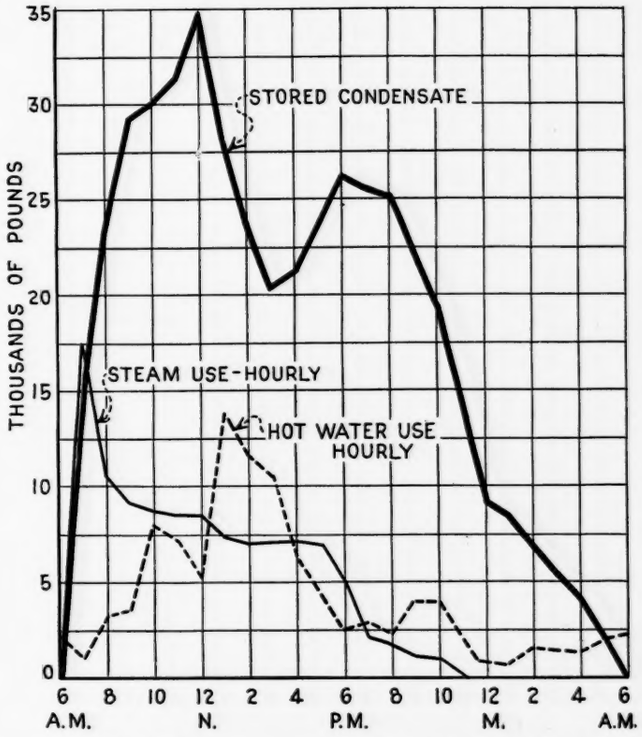


Fig. 3. Graph by means of which the size of the storage tank was determined

N.E.L.A. Power Committee Reports on Marketing Electric Air Conditioning

UNDER the title of "Marketing Electric Air Conditioning" the National Electric Light Association has issued an 18-page pamphlet prepared by a sub-committee of its General Power Committee. The sub-committee consists of H. C. Webb, Virginia Electric & Power Company; F. T. Brooks, Philadelphia Electric Company; J. A. Freeman, Public Service Company of Colorado, and J. W. Wrenn, Pacific Gas and Electric Company.

The general purpose of the pamphlet seems to be to convey information concerning the present and prospective electric loads resulting from air conditioning installations in all kinds of buildings. This is done by statistics, descriptions of the power requirements of typical existing installations, considerable general promotional material setting forth advantages, some suggestions as to selling procedure, and bibliography appended at the back.

By far the greater part of the space is used for describing what air conditioning is, the advantages, the equipment, and brief descriptions of the kind of plants used in typical building classes. Most of these points are already well known to our readers. Stress is placed on those methods which use electric power.

About one page is devoted to describing and analyzing the available market. In the course of the description it is stated that "we have an existing load in this new and growing field for the application of electric power of over 210,000 hp., which probably represents, with average use, the sale of about 167,000,000 kw-hr. annually by electric power companies."

In analyzing the "available" market, the following statements are made:

"Based upon recent studies of the available market for air conditioning equipment, representing immediate prospects, a conservative estimate indicates an electric power demand, not including residences, of approximately 2,200,000 hp. This figure is based on the installation of mechanical equipment to produce 1,315,000 tons of refrigeration, together with the auxiliaries necessary. This total is made up as follows:

	Tons
Industrial	500,000
Theaters	225,000
Stores	120,000
Public Buildings	20,000
Restaurants	150,000
Miscellaneous	300,000

"The foregoing estimate of 2,200,000 hp. of prospective air conditioning equipment would mean an increased winter load of about 485,000 kw., with a consumption of about 900,000,000 kw-hr., and an increased summer load of about 1,450,000 kw., with a consumption of about 850,000,000 kw-hr., giving a total yearly consumption to be expected of approximately 1,750,000,000 kw-hr.

"One of the largest electric power companies in the middle atlantic states recently made a survey of air conditioning prospects in its territory, which showed

TABLE I—Air Conditioning Equipment and Operation in Theatres

No.	No. Seats	Ref. Tons	Connected Load Horsepower	Maximum Kilowatt Demand	Theatre Location	Kilowatt Hours Consumed	Months Operated	Tons per Seat	Horsepower per Seat	Kilowatt Hour per Seat	Kilowatt Hour per Horsepower	Kilowatt Hours per Seat per Month	Kilowatt Hour per Horsepower per Month	Hour Use of Demand
1	1,286	.....	200	.....	N. Y.	83,210	12	.....	156	64 7	416	5.391	34.67	.....
2	1,500	102	247.5	151	Okla.	237,200	11	.068	165	158	960	14.36	87.27	1,570
3	1,700	.....	125	.....	Mass.	69,232	4	.....	0736	40.8	555	10.2	138.75	.....
4	1,733	.....	213	.....	N. Y.	120.849	12	.....	1230	69.5	566	5.791	47.17	.....
5	1,743	.....	127	.....	Mass.	40,940	4	.....	073	23.5	322	5.875	80.50	.....
6	1,847	.....	152	.....	Mass.	51,860	4	.....	0825	28.1	341	7.025	85.25	.....
7	1,960	.....	275	.....	N. Y.	106,460	12	.....	140	54.3	387	4.525	32.25	.....
8	1,962	.....	152	.....	Mass.	50,360	4	.....	9775	25.6	331	6.40	82.75	.....
9	2,000	73	110	63	Kansas	70,160	4	.0365	055	35.1	640	8.775	160.00	1,110
10	2,000	125	231	205	Okla.	101,110	4	.0625	1155	50.6	438	12.65	109.50	495
11	2,000	.....	295,5	169	Penn.	36,500	4	.....	148	18.3	124	4.575	31.00	216
12	2,060	125	230	168	Penn.	68,430	3	.0607	1115	33.2	297	11.07	99.00	407
13	2,100	180	357.5	327	Penn.	361,210	5	.0857	170	172	1,010	34.4	202.00	1,110
14	2,110	150	227.5	155	Penn.	121,530	4½	.0710	108	57.7	535	12.80	119.00	784
15	2,200	.....	312 5	211	Penn.	130,900	5	.....	142	59.5	418	11.90	83 6	620
16	2,300	.....	213	.....	N. Y	172,080	12	.....	0925	75	806	6.25	67.17	.....
17	2,422	.....	320	.....	N. Y	116,132	12	.....	132	48	364	4.00	30.33	.....
18	2,562	.....	370	.....	Mass.	167,400	4	.....	1445	65	453	16.25	113.25	.....
19	2,600	77	160	127	Ohio	146,350	4	.0296	0615	56.3	915	14.075	228 75	1,150
20	2,676	220	428	315	Okla.	402,300	5	.0823	160	150	940	30.00	188.00	1,280
21	2,907	.....	247.5	.....	Mass.	177,710	4	.....	085	61	720	15.25	180.00	.....
22	2,989	.....	325	.....	N. Y	298,670	12	.....	109	100	917	8.33	76.41	.....
23	3,150	.....	415	.....	N. Y	245,667	12	.....	132	77.7	590	6.475	49.17	.....
24	3,200	.....	355	.....	Mass.	199,400	4	.....	.111	62.3	560	15.575	140.00	.....
25	3,300	200	363	199	Penn.	98,445	5½	.0605	.110	29.8	271	5.425	49.25	494
26	3,339	360	525	225	Ohio	237,000	5	.108	157	71	450	14.20	90.00	1,050
27	3,600	.....	350	.....	Mass.	179,600	4	.....	.0972	50	513	12.50	128.25	.....
28	3,600	.....	500	.....	N. Y	223,820	12	.....	139	62	446	5.167	37 17	.....
29	5,000	.....	400	.....	Mass.	336,100	4	.....	.08	67.2	840	16.800	210	.....
30	5,624	.....	610	.....	N Y	330,000	12	.....	.1085	58.7	541	4.89	45 08	.....
Total..	77,470	.....	8,837	.....	.....	4,979,725	21 3	.....	.....	.....	.....	.....	.....	.....
Average..	2,582	.....	294.6	.....	.....	165,990	7.1	.....	114	64.2	563	9 04	79 3	.....

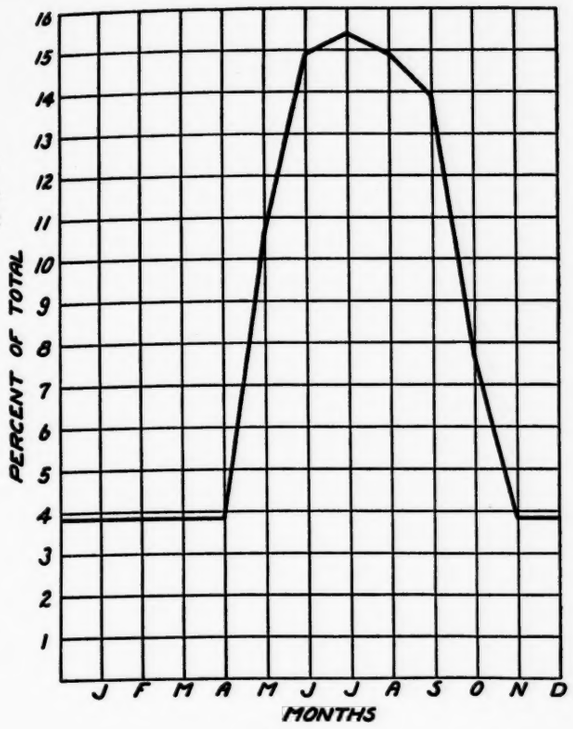


Fig. 1.

that the total potential air conditioning load available from industrial and commercial customers is equal to about 18% of the total connected load of those classes of customers. It further indicated that while the annual load factor of the total load would be somewhat low, nevertheless, about 75% of the demand, and somewhat less than 50% of the current consumption, is due to the refrigeration and auxiliary equipment and occurs during the summer months, while about 25% of the demand and over 50% of the energy consumption would be spread over the entire year."

It should be noted that this analysis is another of those set up in terms which give no clue as to how soon these totals of availability may be converted into actuality. Quite naturally this conversion time depends on selling effort among other factors, but it is always interesting to learn how soon these developments may be expected to take place.

In describing industrial plant installations an interesting graph is presented showing how the electric consumption was distributed over the year in a Philadelphia installation. This graph is reproduced here as Fig. 1. It shows that the five winter months accounted for approximately 20% of the annual consumption, while the three summer months accounted for over 45% of the total. This figure is presented in the report without comment, but an interesting analysis may be based upon it if one wishes to do so, for, like so many graphs, the interpretation can be made to suit the objective.

In discussing the use of air conditioning in commercial buildings, the following figures are given as the total number of present complete installations in certain building types.

Theaters	300 +
Department stores	25 (approx.)
Office buildings	12 —
Hospitals	1
Hotels	2 or 3
Banks	12 (approx.)

The most interesting numerical data given in the report are tables which show the electric power figures in 30 theaters in various parts of the country, and in 19 commercial buildings of four types. These are Tables I and II of the report, and are here reproduced in full.

TABLE II—Air Conditioning Equipment and Operation in Commercial Buildings

No.	Volume Cubic Feet	Floor Area, Square Feet	Ref Tons	Horsepower Connected	Maximum Kilowatt Demand	Location	Kilowatt Hour Consumed	Months Operated	Tons		Horsepower Connected		Kilowatt Hour			Hour Use of Demand	Kilowatt Hr per Month		
									1000 Cubic Feet	1000 Square Feet	1000 Cubic Feet	1000 Square Feet	1000 Cubic Feet	1000 Square Feet	Per Horsepower		1000 Cubic Feet	1000 Square Feet	Per Horsepower
1	.....	15,000	.....	100	81	Texas	20,400	12	.....	.....	.....	6.67	.....	1,360	204	252	.....	113.3	17 0
2	30,417	2,347	15	24 5	14	Kansas	13,900	4	.493	6.4	.805	10 42	457	5,930	568	994	114.2	1,482.5	142 0
3	109,200	7,875	.....	18	9	Kansas	9,260	4	.....	.....	.165	2.29	85	1,175	515	1,030	21.3	293.7	128 7
4	227,000	.....	75	131 5	48	Cal.	44,120	6	.33	.....	.580	.....	194	.....	336	920	32 3	.....	56 0
5	239,400	12,350	.....	31	14	Kansas	19,720	4	.....	.....	.130	2.51	82	1,600	637	1,410	20.6	400	159 2
6	304,875	18,200	50	100	64	Kansas	66,269	5	.164	2.75	.328	5.50	218	3,640	663	1,034	43.6	728	132 6
7	900,000	.....	90	272	210	Cal.	131,547	6	.100	.....	.302	.....	146	.....	484	625	24.4	.....	80 7
8	1,200,000	.....	100	246	132	Cal.	158,020	6	.0835	.....	.205	.....	132	.....	644	1,200	22.0	.....	107.3
9	1,613,700	131,300	150	.....	.....	N. Y	80,770	12	.093	1.14	.....	.....	50	615	.....	.....	4.2	51	.....
10	2,963,000	226,000	600	.....	.....	Mich.	1,000.000	7	202	2 65	.....	.....	338	4,430	.....	.....	48.3	633	.....
							DEPARTMENT STORES												
1	1,794,000	160,000	410	.....	.....	.....	15,923	12	228	2.56	.....	.....	8.9	99 8	.....	.....	75	8.3	.....
2	156,000	9,250	50	80	50	Ohio	44,000	4	.321	5.40	.513	8.65	282	4,760	550	880	70 5	1,190	137 5
3	138,000	11,700	.....	30	20 7	Kansas	14.847	4	.....	... ..	217	2.56	107.8	1,270	495	717	26 9	317 5	124
							RESTAURANTS AND CAFETERIAS												
1	89,760	.....	.....	70	54	Penn.	46,659	6	.....	.....	.780	.....	520	.....	667	864	86.7	.....	111
2	99,000	.....	85	113	86	.....	20,258	2	.86	.....	1.14	.....	204	.....	179 5	235	102.0	.....	89.75
3	29,700	2,700	14.5	23	17.2	Kansas	23,808	4	.488	5.37	.775	8.52	805	8,830	1,035	1,390	201.25	2,207.5	258.75
4	139,000	12,644	53	.....	.....	.....	158,000	.....	.381	4.19	.....	.....	1,138	12,500	.....	.....	.....	.....	.....
							HOTELS												
1	280,000	.....	200	300	153	Ohio	209,150	6	.714	.....	1 07	.....	748	.....	695	1,365	124.7	.....	116
2	246,000	.. .	75	200	100	Ohio	138,375	6	.305	.....	.813	.....	563	.....	691 9	1,383 7	93.8	.....	115 3

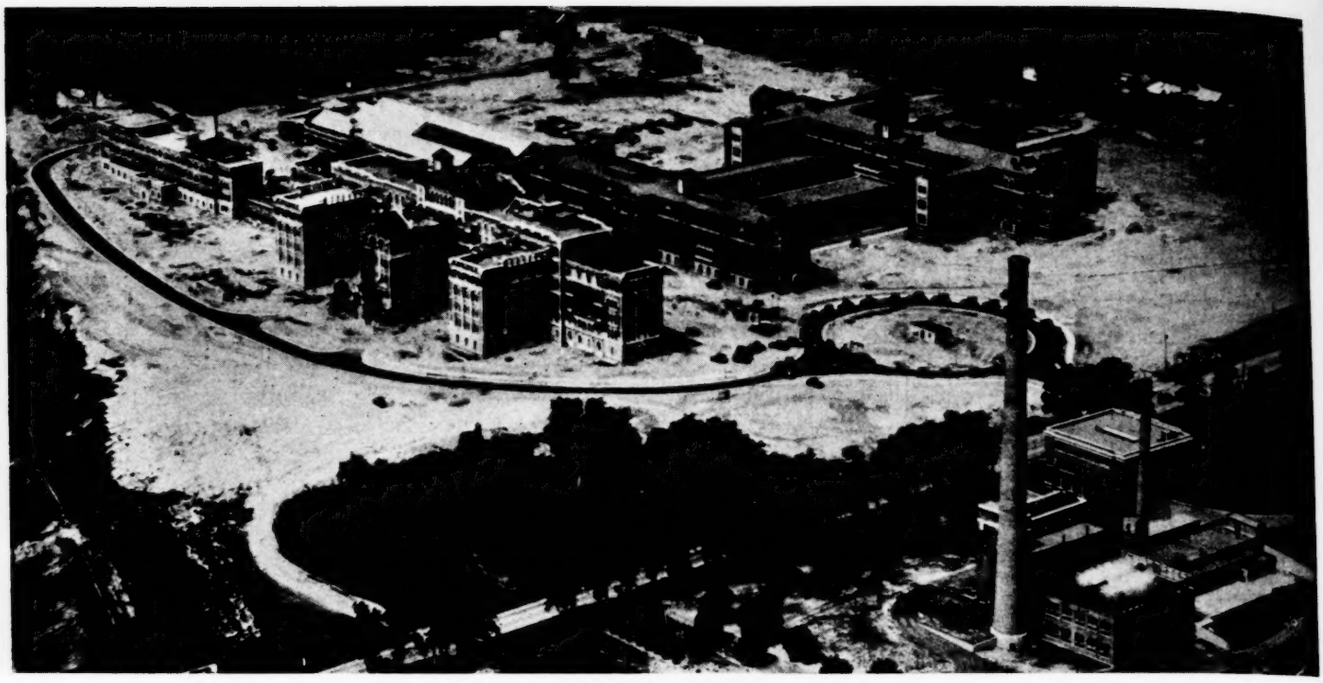


Fig. 1. Air view of Monroe County Home.
Power plant and service building shown in lower right. Note spray pond on power plant roof. Right center, Unit 3; center, Unit 2; left center, Unit 4; upper left center, Units 5 and 6; upper center, Units 7 and 8.

Heating and Ventilating a County Home with 123,000 Sq. Ft. of Radiators

By FRANK L. WADSWORTH†

THE old group of buildings comprising the Monroe County Home, Hospital, and Penitentiary, Rochester, N. Y., were built about 75 years ago, and have become obsolete and inadequate in many respects.

Six years ago the children's hospital and nurses' home at the Monroe County Tuberculosis Sanatorium (known locally as Iola Sanatorium) were built, the boiler house enlarged, and new boilers and refrigerating equipment installed. The entire heating system at Iola was revamped, and an increase in the electric service from the power company was found to be necessary. Further additions to this institution were completed last year.

It had originally been planned to remodel and add to the existing county home and hospital, and to double their capacity, but it was found upon investigation that, due to extremely thick masonry walls and heavy wood construction, modernizing these buildings would be very expensive, and construction of the new units on available land adjacent to Iola Sanatorium proved to be more expedient. These are nearing completion.

The project was divided into a number of separate units (see Table 1) to enable more contractors to work on the job, and also to make the several contracts of such size that local contractors could handle them and thus eliminate out-of-town competition. Local contractors were successful bidders in all cases. The accompanying plot plan shows the location of the various parts of the construction, the new group being to the west of East Henrietta Road.

†Engineer, Staff of Siegmund Firestone, Architect and Consulting Engineer, Rochester, N. Y.

Size of the Plant

Radiation in the existing group (Iola) amounts to 48,000 sq. ft., bringing the total for the entire institution to 123,262 sq. ft., requiring 30,815 lb. of steam per hour for peak load in zero weather, based on a condensation rate of ¼ lb. per sq. ft. of radiator per hour. Hot water requirements for the new buildings total 12,000 gal. per hr., maximum, and for the old sanatorium, 8000 gal. per hr., maximum. Approximately 21,120 lb. of steam are required per hour to heat 20,000 gal. of water from 40° to 180°. The total peak steam load is therefore 51,935 lb. per hr., exclusive of feed water heating.

Since the same power plant serves both the new county home and the tuberculosis sanatorium, an outline of the Iola Sanatorium and its piping system, particularly through the tunnels, will be given first.

Iola Sanatorium

Until about six years ago, the Iola Sanatorium consisted of the power plant and laundry, service building,

TABLE 1

UNIT NO.	DESCRIPTION	DIRECT RADIATION OR EQUIVALENT (SQ. FT.)
1	Addition to Iola power plant and tunnel connecting to administration and women's building	.....
2	Administration and women's building. Four stories, accommodating 200, also female help, matron, etc. One floor divided into 28 rooms for married couples	16,134
3	Men's building. Four stories, accommodating 692. Quarters for male help	21,325
4	Infirmary. Six stories, normally accommodates 400. Additional story in tower in center.....	25,100
5	Nurses' home. Four stories, accommodating 85 nurses, matron, assistant, etc.	5,860
6	Service building. One story, containing garage, laundry, bacteriological laboratory, and shops.....	*6,843
7, 8, 9, 10	Include dwellings, grading roads, etc. The dwellings have separate heating plants.	
	Total radiation.....	75,262

**Includes 24 unit heaters equivalent to 5660 sq. ft. of direct steam radiation.*

superintendent's residence, pavilion B, infirmary, administration building, in which was the nurses' dormitory, pavilion C-1, and pavilion C-2.

When the children's hospital and nurses' home were planned, it became necessary to increase the capacity of the boiler house. Of the three, 150 hp. horizontal return tube hand-fired boilers then existing, one had been condemned and the other two were to be assigned a reduced working pressure, due to old age, so two 2500 sq. ft. cross drum water tube boilers were installed. Also, the ammonia refrigeration plant was located in the basement of the infirmary, constituting a serious hazard to the three floors of bed patients upstairs.

In addition, the existing underground tunnel connecting the power plant with the several buildings was small, being 6 ft. high by 4 ft. wide, with steam and return lines on one side, and electric feeders (not in conduit) strung along the other side. These constituted a source of danger, and being already loaded to capacity, new ones were necessary for the increased load. It was decided, therefore, to abandon the old tunnel and construct a new one to connect all the buildings and have it sufficiently large to be used as a passageway between buildings. All washing for Iola is trucked through the tunnels to the laundry which has been located over a portion of the power plant.

There is a total of 1850 ft. of tunnel at Iola, the passage being 8 ft. high by 7 ft. wide from the power plant to the infirmary, and then down to the children's hospital, with an 8 ft. high by 6 ft. wide tunnel extending to the nurses' home. Branch tunnels 8 ft. high by 5 ft. wide connect the main tunnels to the service building, pavilion B, the administration building, pavilion C-1, pavilion C-2, and to the new staff home, which was built last year. The steam, return, hot water, and circulating lines to the superintendent's residence are carried underground from the main tunnel in a 12 in. conduit, and the cold water and gas service lines are buried in the ground. Piping through all this tunnel system was complicated by change of grade and expansion and contraction.

To conserve space and make a neat installation, all piping was installed on the tunnel ceiling. To provide both ventilation and access to valves and expansion joints, six penthouses were built, approximately 9 ft. x 9 ft. outside measurement, and projecting about 6 ft. above the ground. These have had shrubbery planted about them and are not conspicuous. They are of concrete, with concrete, tar, and gravel roof, and steel sash on four sides, one of which is hinged so that an engi-

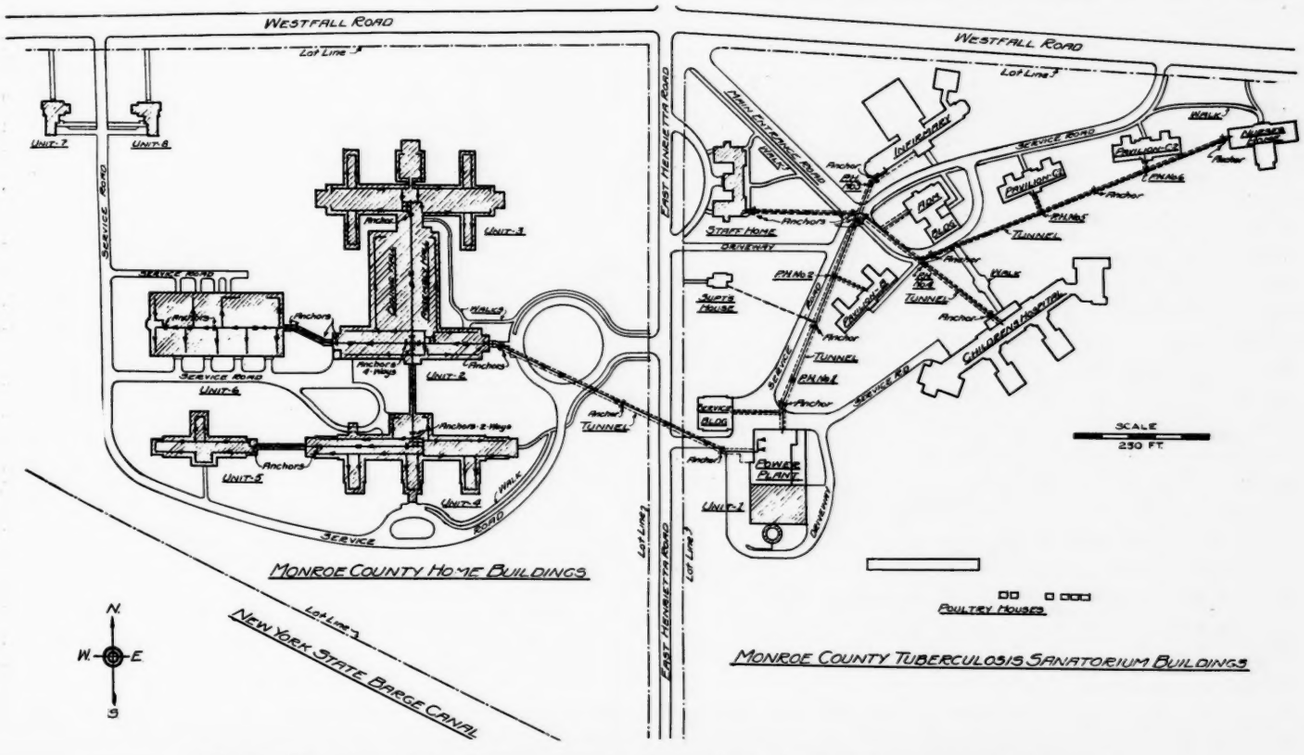


Fig. 2. Plot plan of the Monroe County Sanatorium, showing arrangement of mains

neer or maintenance man can enter from outside and work from above the pipe. All expansion joints and sectionalizing valves are located at these penthouses, and any section of line between any two penthouses can be shut off temporarily for repairs.

Pipe Supports

Pipes are supported as follows: Pieces of 2½ in. x ½ in. galvanized flats 14 in. long were placed in the tunnel wall forms before the concrete was poured, 8 in. in the concrete and 6 in. projecting into the tunnel, the projecting portion being drilled 13/16 in. for a ¾ in. bolt. These flats were placed 7 ft. from the tunnel floor, and spaced at not greater than 10 ft. centers. Across the tunnel, resting on these flats, were placed 3½ in. x 3 in. x ½ in. angles, with the 3½ in. leg down, the ends being notched with a U instead of drilled to facilitate sliding in place, and fastened with the ¾ in. bolts previously referred to. After pipes were in place, steel plates 6 in. wide by ½ in. thick were notched out to fit the various lines and bolted to the vertical legs of the angle supports to form guide plates to keep all pipes in alignment. At anchor joints, heavier and wider flats were used, and 8 in. channels laid across with flanges down. Pipes were anchored to these channels with U-bolts, varying in size to suit the individual line.

Double slip expansion joints with 4 in. travel on each end and base anchors were placed at each penthouse, secured to 8 in. H-columns extending horizontally across the penthouse with ends laid 8 in. into the concrete walls and securely anchored into them. The bases of the expansion joints were bolted to the underside of these H-sections, the smaller joints being shimmed down so that the bottom of all pipes would be level and ride on the hangers. In addition, planks can be laid across the column sections for men working in the penthouse. There are two rows of expansion joints in each penthouse, those on adjacent lines being staggered to allow for joint packing operations.

Referring to the plot plan, and starting at the power plant, we proceed upgrade through the tunnel to the first turn and anchor all lines. Expansion toward the power plant is taken care of there by change in direction of the pipe. The first set of expansion joints is at penthouse No. 1. Midway between penthouses No. 1 and 2, all pipes are anchored. Penthouse No. 2 is located at the intersection of the branch tunnel to pavilion B, and branch lines to pavilion B are taken off service outlets in the expansion joints. At the point where the tunnel leading down to the children's hospital branches off to the right, the lines are again anchored. The new branch to the staff home is also taken off at this point, bearing to the left. Where the tunnel changes direction near the infirmary, a set of single expansion joints was placed, and a short distance beyond this point the lines enter the infirmary building.

Returning to the intersection just described, we proceed downgrade toward the children's hospital where the line to the administration building branches off. These lines are taken off with swing joints. Expansion joints at penthouse No. 4 take care of the lines in this section of the tunnel, with anchors at each end of the line.

Branch mains extending up to pavilions C-1 and C-2 and the nurses' home are taken off service outlets on the expansion joints at penthouse No. 4 and anchored shortly after changing direction.

At the entrance to pavilion C-1 is penthouse No. 5 and another set of expansion joints, and a similar arrangement is located at the entrance to pavilion C-2, where penthouse No. 6 is placed. Midway between these two joints, and also at the entrance to the nurses' home, all pipes are anchored.

The grades are such that all returns, excepting those from the children's hospital, flow back to the power house by gravity. While the returns from pavilions C-1 and C-2 and the nurses' home have to flow up-hill for about 140 ft. while going through the section of tunnel leading from the children's hospital, the elevation of these buildings is so much higher that the head overcomes the pocket in the return lines. This return is carried along the tunnel wall through this section with lift fittings installed at the intersection with the main tunnel.

Steam leaving the power plant at 100 lb. pressure is carried to the various buildings through two lines, one 6 in., and the other 3 in., for winter and summer use, respectively, and is reduced at each building to 40 lb. for kitchens and sterilizers and to ¼ lb. for heating. The 100 lb. pressure was adopted so as to permit the use of standard weight pipe, fittings, and valves for 125 lb. working pressure.

All high pressure returns are trapped to flash tanks venting into the heating system, and flash tanks trapped into the vacuum returns. Returns from the children's hospital are pumped back up-hill through the tunnel to the main intersection, where they connect into the gravity line, which in turn connects to steam-driven vacuum pumps in the power plant, so that the entire institution is on a vacuum heating system.

Hot water is circulated from the power plant through a 4 in. line on a loop system in and out of each building, with by-passes at strategic points, so that any building may be cut out without interference with the rest of the system. After leaving the last building, the loop becomes a 2 in. circulating line back to the pump in the power plant. Water leaves the power plant at 180° and after passing through about 4000 ft. of pipe, returns at 170°.

A study of present and anticipated power needs revealed that it would be more economical to produce power than to purchase it from the utility company, especially in view of the heavy demand for low pressure steam.

During the past winter up to May 1, there was never sufficient low pressure steam to fulfill the heating requirements, and live steam, via reducing valves, was required to meet the demand. Of course, full heating and electric load will not be experienced until next winter. However, an emergency standby power service is maintained and enough purchased power used to consume the demand charge. The power plant was enlarged to meet the new conditions, and two additional cross drum water tube boilers were installed. These have rear water walls and air-cooled side walls, and each has 5510 sq. ft. of surface. They were built for 200 lb. water gauge.

Electric power is supplied by two 500 kw. turbo-

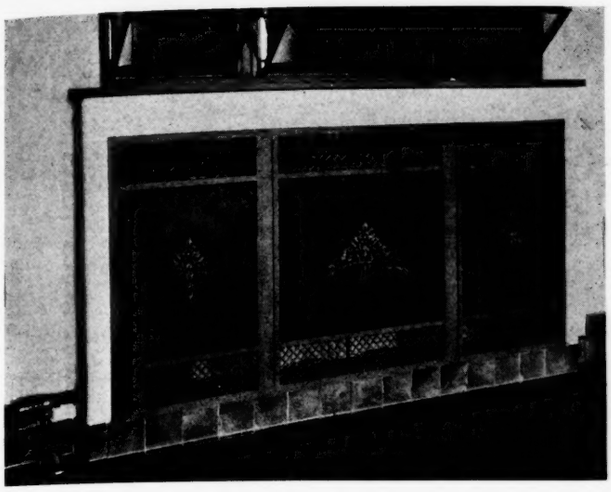


Fig. 3. Close-up of radiator in assembly hall. Due to limited size of radiator enclosures, valves were placed outside to allow more room for radiators inside

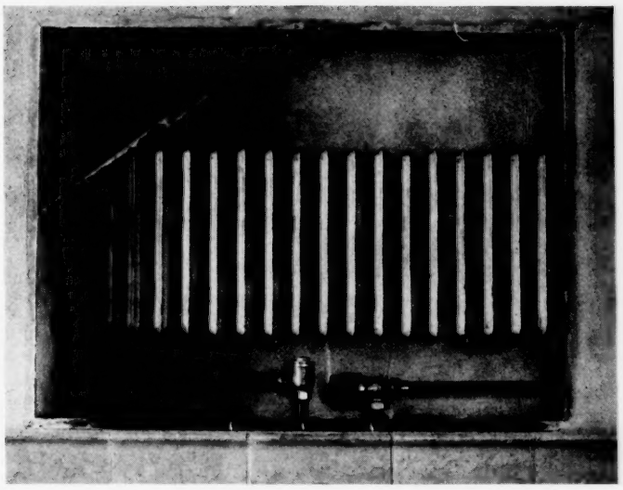


Fig. 4. Radiator in detention ward, Unit 4. When completed will be covered with reinforced steel plate locked access door. Asylum-type grilles will be placed near floor for intake, and similar grille near ceiling for outlet. By removing steel cover, radiator and all piping may be removed and replaced without tearing out any walls

generators, operating at 3600 r.p.m. Turbines are 6-stage automatic extracting, and are operated condensing. They carry full load with steam at 175 lb. pressure at the throttle, and extract all steam at 20 lb., with the exception of 1200 lb. per hr. to keep the lower stages cool. At full load, these turbines pass 25,000 lb. of steam per hour, 23,800 lb. of which can be bled at 20 lb. pressure.

A 12 in. extraction line from each turbine connects into a 12 in. header from which a 6 in. and two 5 in. lines lead to the three hot water storage heaters. Two of these heaters also have high pressure connections from the 100 lb. main for use in case of a shortage of low pressure steam. The feed water heater is supplied with steam at 8 lb. pressure through either or both of two 6 in. reducing valves from the 20 lb. extraction line.

(To be continued)

Hill Investigates Effects of Electric Heating

Prof. Leonard Hill, the English scientist who for some years past has been carrying out important experiments in domestic heating and ventilating, has announced that he recently made the curious discovery that the prickly sort of heat felt on facing an electric heater is "notably relieved on bringing close to the face an incandescent lamp screened by a sheet of glass. The one set of rays acting on the skin antagonizes the other set." The effect, however, does not result if a sheet of gelatine or cellophane is substituted for the glass screen. The lamp and the screen in front of it are, of course, so placed as not to shade the heater. Professor Hill also finds that the rays from an electric heater or dark source of heat cause congestion of the nose and feeling of stuffiness as a result of acting on the skin reflexly. This is not the case with everybody, but those who have a deflected septum and some nasal obstruction are particularly susceptible to this congestion. Those with widely-opened noses may be made sensitive by means of a screw nose-clip adjusted so as partially to obstruct their noses. The rays from an incandescent lamp also counteract these "nose-closing" rays, and in this case the counteracting rays may act on a part of the skin other than that irradiated by the electric fire. A square inch of skin suffices to obtain the reflex on the nose, and the sources of the rays may be put many feet away. The sensitivity of certain people to these rays is very great.

"Cooling the face prevents the nose-closing effect," Professor Hill continues, "hence the importance of ventilating rooms with cool air. The skin when wet with perspiration is protected from the 'nose-closing' rays, and it is noteworthy that a screen of invisible vapor rising from a bowl of water set in front of an electric fire or dark source of heat has the same protective influence. As the bowl, to be effective, must be placed between the source of heat and the skin, its influence is not due to a general humidification of the air of the room. It is remarkable that a dense cloud of steam, or a layer of water, does not protect the skin from the 'nose-closing' rays. The Ilford screen used for the wonderful new infra-red photographs transmits infra-red rays which are not scattered by the mist in the atmosphere. This screen permits the 'nose-closing' rays to pass and cuts out the 'nose-opening' ones; so also do screens of cellophane and horn. Glass, on the other hand, absorbs most of the 'nose-closing' rays and lets the 'nose-opening' ones through. Spectroscopic study of the screens shows that the 'nose-opening' rays belong to a group about 20,000 to 30,000 Augustrom units in the region of the shorter infra-red rays.

"Sources of heat like the open fire or modern gas heater are pleasant because they give off these beneficent rays in sufficient quantity. Electric heaters can be made as pleasant by putting more current through the wire and so making them bright instead of dull red. The use of the bowl of water in front of stoves can be shown, and the need for ventilation of all rooms with cool air made evident by very simple experiments."—*A. C. Blackall,* London.

High Vacuum Gives Better Boiler Efficiency Under Normal Loads

By R. A. NORMAN†

Results of tests show that the higher the vacuum the better the boiler efficiency under light loads. Since the tests cover low pressure steam heating boilers which operate at or less than half their rating the greater part of the year, this idea is of considerable interest to operating engineers.

FOR a number of years the university with which the writer is connected has received requests for information as to the performance of heating boilers when operating at high vacuums. Not being able to find such information in the form suitable to our needs we decided to run a series of tests with the thought that the information would be of interest to heating engineers.

The tests were made on a gas-fired steam boiler, gas being used because of the convenience of firing. City gas with about 535 B.t.u. per cu. ft. heating value was used. The arrangement of the apparatus for the testing followed the method recommended by the American Gas Association.

Forty-four separate and complete tests were run. The duration of tests was three hours. The vacuum maintained for each load was kept practically constant. There were six different loads carried, 17, 30, 47, 60, 78 and 100% of the boiler rating. For each of these ratings the different vacuums carried were approximately 0, 5, 10, 15, 20 and 25 in. of mercury.

The room in which the tests were conducted was subject to wide variation in temperature due to weather. A room temperature variation of as much as 30° was recorded when comparing runs on different days. A correction was made for this variation on those curves affected by temperature differences.

In Figs. 2, 3 and 5 the number of the curve refers to the load in per cent of boiler rating as follows:

1 — 100%	3 — 60%	5 — 30%
2 — 78%	4 — 47%	6 — 17%

Fig. 1 shows how the efficiency varies under varying

†Professor of Mechanical Engineering, Iowa State College, Ames, Iowa.

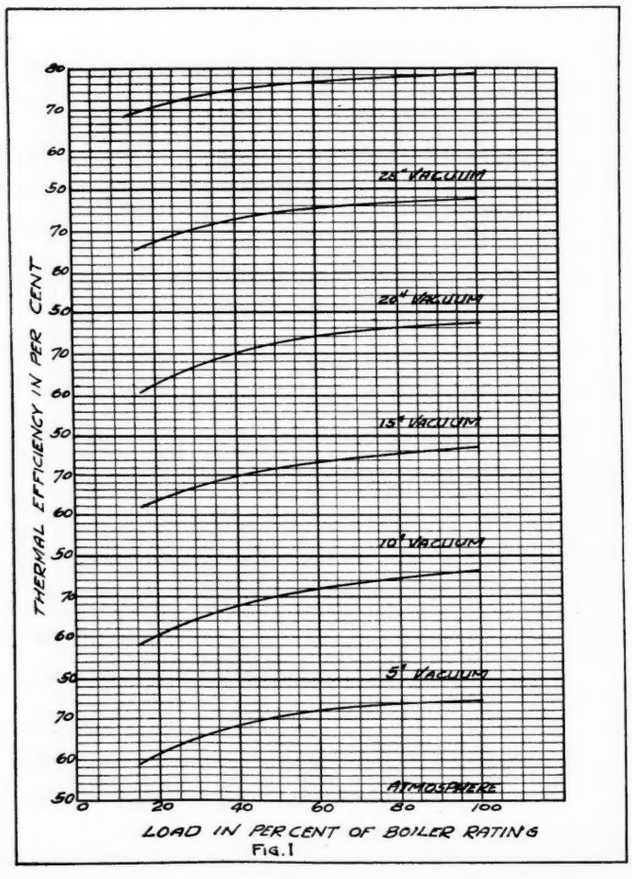


Fig. 1

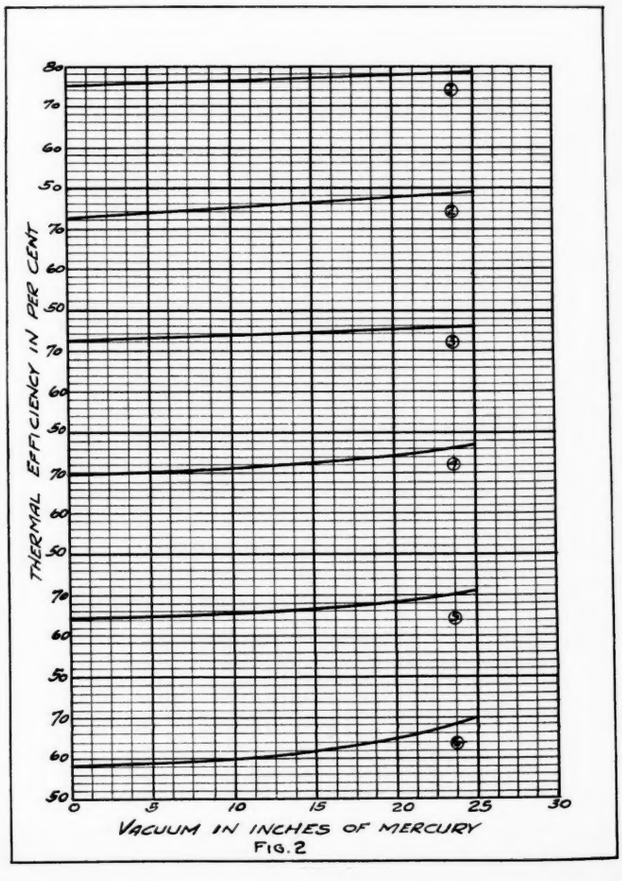
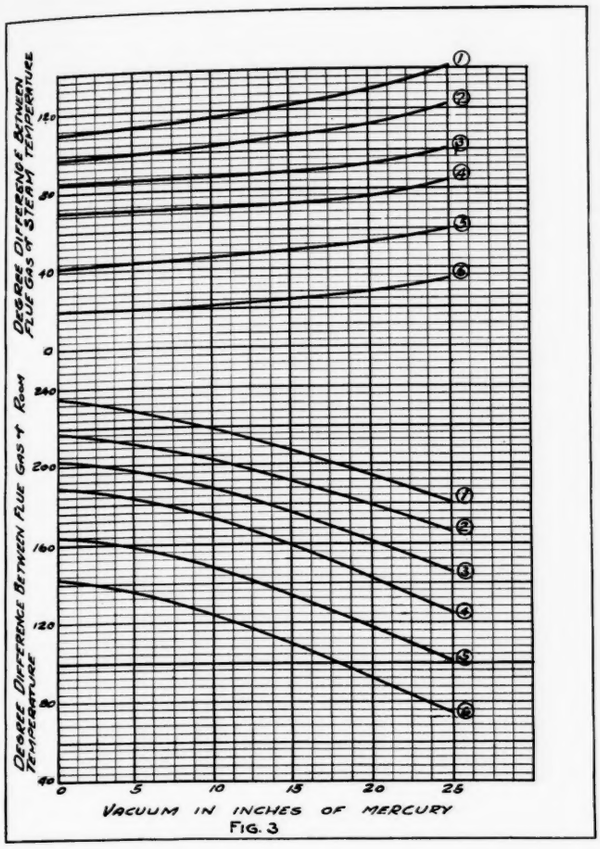


Fig. 2


DEGREE DIFFERENCE BETWEEN FLUE GAS & ROOM TEMPERATURE
DEGREE DIFFERENCE BETWEEN FLUE GAS & STEAM TEMPERATURE
VACUUM IN INCHES OF MERCURY
FIG. 3

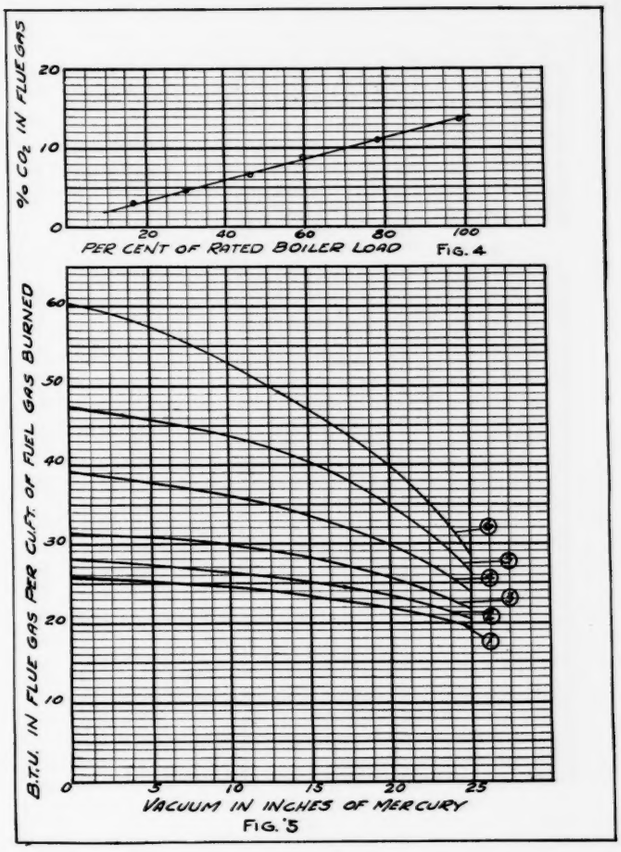


FIG. 4 FIG. 5

loads for a given pressure. The high vacuum curve shows the highest efficiency, nearly constant throughout the load range.

Fig. 2 shows the effect on efficiency by varying the vacuum. These curves indicate that with light loads high vacuum produces better boiler performance.

The curves plotted (Fig. 3) between temperature difference and vacuum show declining temperature differences with the higher vacuums which account for a large part of the improved operating performance. This saving effect is better shown on Fig. 5 which indicates that the heat loss in the chimney gases per cubic foot of gas burned tends to approach a common value as the vacuum increases.

Where varying vacuums are used for controlling heating systems to meet the varying weather conditions, the tests show boiler performance in favor of such a method.

In these tests no attempt was made to determine the cost of maintaining the variable pressures. This item would depend very largely on the tightness of the system.

The tests were conducted during the summer of 1930 by Wallace H. Martin of Corvallis, Oregon, under the direction of the mechanical engineering department cooperating with the Engineering Experiment Station of Iowa State College. For this work Mr. Martin received graduate credit toward his M.S. degree in mechanical engineering.

Trap Not Always at Fault

ENGINEERS who have had occasion to work with heating systems may find the following incident helpful during the coming heating season:

An engineer for a 40-story skyscraper some time ago installed an inverted bucket trap of proper capacity at the base of the main steam header which supplied the heating radiation. This steam for heating was purchased from a central heating company which delivered it at a uniform pressure of 125 lb. A reducing valve was used to let the steam into the building. In cold weather the reduced pressure would drop as low as 30 lb., but in warm weather the pressure would be as high as 50 lb. On warm days the trap operated perfectly, but when the pressure dropped below 37 lb. the trap ceased to operate.

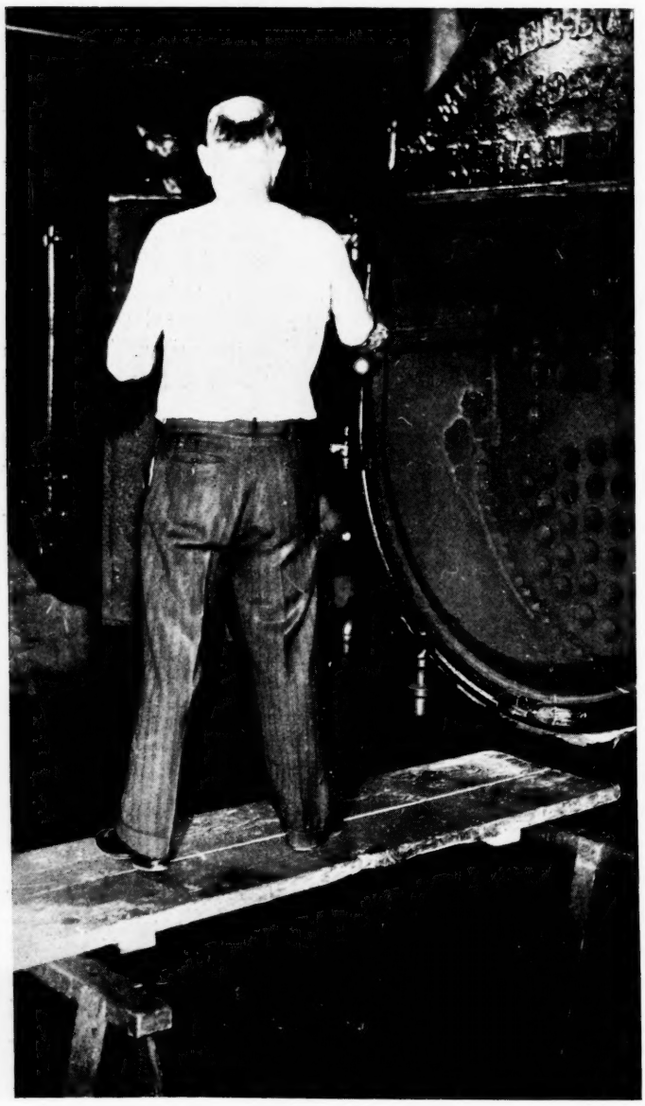
This mysterious behavior pointed accusingly toward the trap until the real cause was discovered. Here is how it happens: Fairly dry steam expanded from 125 lb. to 30 lb. will gain about 15° of superheat and, consequently, there is no condensate to remove from the supply header. But when reduced to only 50 lb., there is little, if any, superheat and a normal amount of condensation occurs in the header.—*T. H. Rea in the Armstrong Trap Magazine.*

Operating Economy Obtained by Use of Boiler Room Instruments

By JOHN A. MASEK†

IN recent years, the increasing cost of operating buildings is making it difficult for the majority to make expenses. The number going into receivership throughout the country is conclusive proof of this fact. It is bringing about a realization that economies must be effected wherever possible in order to survive. The amount of fuel consumed per season is compelling more thought now than ever before.

†Chicago, Ill.



Sufficient space behind the boiler makes it possible to clean boiler fire tubes easily and quickly. Overlooking this feature means that 10% to 15% of the fuel burned will go up the chimney.

Consequently, both designing and operating engineers are giving more attention to the proper use of equipment which is available for utilizing the fuel burned in the heating system with maximum economy. The use of instruments as an aid to the efficient operation of plants is receiving attention in places where previously such devices were not even considered. In short, recognition is being given the fact that relatively small investments in first costs of instruments more than pay for themselves in operation.

One of the important advantages of instruments in connection with the heating system of buildings is that it enables the operator to keep records which will enable the management and the engineer to determine whether the system is being well operated. Otherwise, this can be determined only through tenant complaints or excessive costs.

What One Building Manager Did

These points can be better illustrated by an actual example. The management of a group of buildings in Chicago observed that the fuel costs in some of the smaller buildings were higher than in larger buildings. An investigation showed that some of the firemen were far more careful than others, but that due to faulty design some were hampered by such obstacles as insufficient space back of the boilers to clean the boiler flues.

It was decided to overcome these shortcomings on the next project, a new hotel building. The supervising engineer, a practical man, was told to cooperate with the architect's office and make such suggestions as he felt necessary.

While this Chicago building is not particularly exceptional, yet it is unusual in that effort was made at the start toward economical operation. Many of the recommendations made by the supervising engineer were objected to by the architect on the claim that it would raise the cost of the building. The points insisted on, and finally incorporated in the heating system, are of interest:

1. A sub-atmospheric steam heating system was installed. This system was more or less new at the time,

but showed possibilities as a fuel saver over the ordinary vacuum return system.

2. Sufficient space was provided in the back of the boiler so that the flues could be cleaned with a single rod flue scraper.

3. A separate pump room was provided for all pumps away from the boiler room.

4. Riser drip traps ending at the fourth floor were placed in the basement where they could be inspected, instead of installed in concealed compartments on the ceiling of the third floor.

5. An instrument panel was provided in the boiler room with a number of essential instruments placed upon it to make it possible to maintain efficient oil firing.

The Instrument Panel

To make possible the obtaining of operating data the instrument panel was installed in front of the boilers. The instruments on the panel indicate the outside and inside temperatures, and steam pressure on one chart. The CO_2 meter indicates and records the flue gas content. Two additional thermometers record the temperature of the flue gases. Inclined tube gauges show the draft of each boiler at all times. Two compound gauges at the top of the panel indicate the steam header pressure and the vacuum in the return mains.

There are three fireman shifts. Each was told to fire according to the instruments. While they have other duties to perform they must make observations not more than an hour apart. It was decided to have the controls semi-automatic. Each man is held responsible for the amount of oil burned during his shift.

Instrument control eliminates guessing. The operating engineer has instructed each of the men as to the proper firing methods. They were told to watch the CO_2 meter, and that for best operation a 12% to 14% reading was desired, and the air intake controlled accordingly. This, however, will vary with the load demand, wind direction, wind velocity, all of which will exert an outside influence. With small loads on a mild day, a CO_2 of 10% would be expected.

The outside and inside temperatures are watched, and the steam pressure regulated according to the demand. Oil burners are adjusted as needed, making it possible to burn a minimum amount of fuel. The ease with which oil can be consumed requires constant attention. Steam pressures are varied with weather conditions by readjusting the weights at the pressure reducing valve.

Stack Temperatures

Ample space provided behind the boiler makes flue cleaning possible within 15 min. The value and the necessity of cleaning the boiler flues daily was demonstrated to the firemen by not cleaning them for a week. It was observed that the flue gas temperature rose around 20° daily, or a total of 100° in less than a week.

Average stack temperatures around 240° prevail most of the time, but fluctuate to 300° depending upon conditions. Thus, the recording thermometer made the firemen realize that the order to clean the flues daily was not given merely to keep them busy, but that actual results are made possible in fuel saving. Greater heat absorption takes place when flues are clean and a low stack temperature is carried.

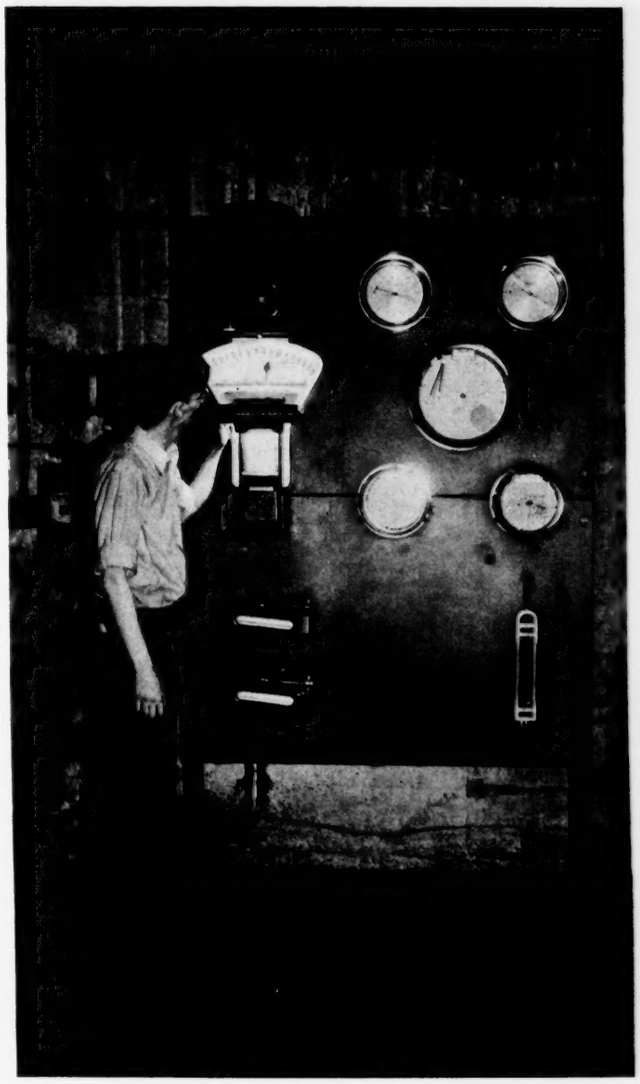
Oil Measurements

When each man starts his shift he measures the oil used in the previous period and turns in his readings without knowledge of the other men's figures. This plan avoids faking in the actual amount of oil used per shift, which was experienced at first. A sample record of this is tabulated below.

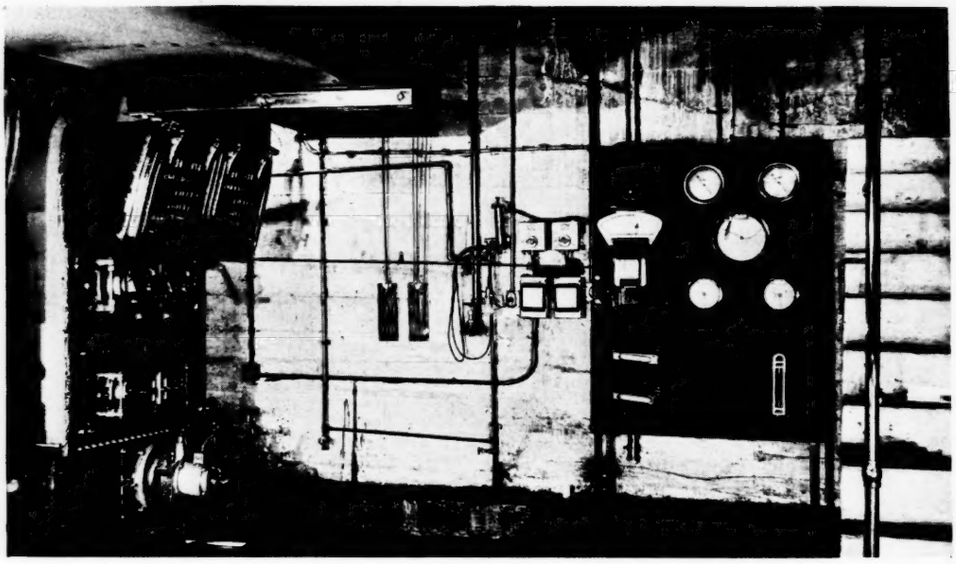
Tuesday—March 1, 1932
5 a.m. — 33½ in. (start)
Noon — 31¾ in.
3 p.m. — 31 in.
11 p.m. — 28½ in. (off)

Wednesday—March 2, 1932
5 a.m. — 28½ in. (start)

The measurements are taken by dropping a calibrated stick through the manhole at the top of the rectangular 7,000-gal. oil storage tank. The use of the gauge on the board for this purpose was abandoned due to inaccuracies in readings.



Mounting important instruments on a single panel makes it possible to study the varying conditions at a glance.



An instrument in front of the boilers makes its installation accessible for observation. The oil burners are adjusted with weather conditions, resulting in fuel economy.

The operating engineer then tabulates this information in a record book and converts the readings to gallons, with outside temperatures for comparison.

December 1
435 gal. used.
Max. temp. 39°
Min. temp. 33°

December 2
570 gal. used
Max. temp. 28°
Min. temp. 6°

December 3
370 gal. used
Max. temp. 30°
Min. temp. 7°

Analyzing Charts and Operating Data

From a study of the outside temperatures, steam pressure maintained, inside temperatures, CO_2, and flue temperature charts, the operating engineer can fairly well determine how attentively and efficiently the boiler was fired. Any unusual changes or conditions are noted on the recording charts. With this procedure the full value of the instrument indications are derived and a return on the cost of the instrument panel is realized.

The data are finally transferred to the daily heating record and fuel consumption chart. The chart is a month's record of the amount of oil used, shown graphically, based on the averages above or below the amount consumed on corresponding days of preceding years. Only the actual data required are kept, which simplifies the procedure of keeping records.

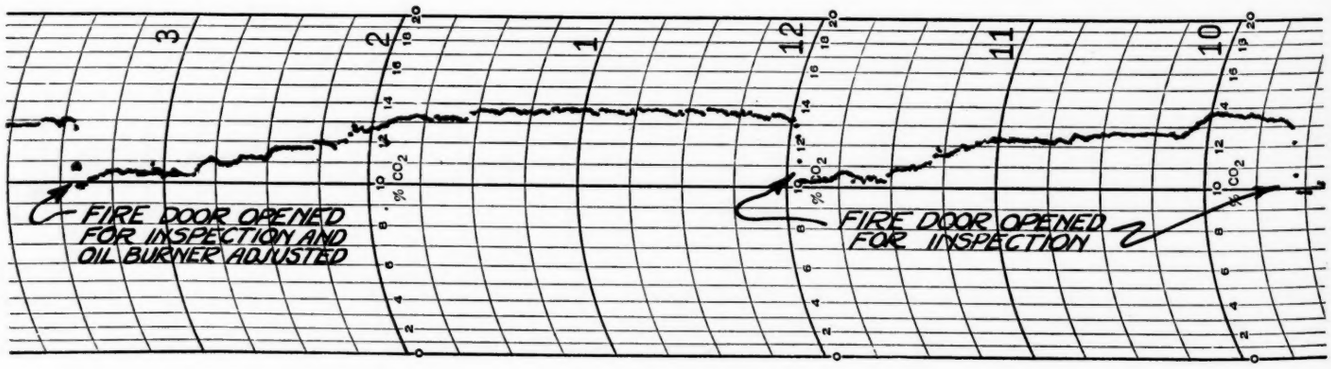
Heating Seasonal Record

The following record gives the total fuel oil consumption for each heating season, along with the cost of heating each square foot of radiation based on the cost of the fuel oil.[1]

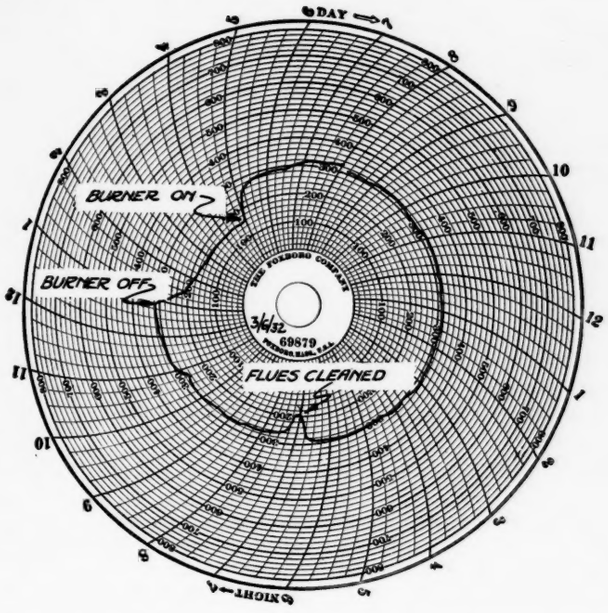
	Sq. Ft. of Dir. Rad. Installed	Total Gallons Purchased	Cost of Fuel Oil for Each Sq. Ft. of Dir. Rad.
Aug. 1928 to June, 1929	18,000	89,485	21c
Sept. 1929 to June, 1930	19,200	80,012	18c
Sept. 1930 to June, 1931	19,200	75,790	17c
Sept. 1931 to June 1, 1932	19,200	68,158	16c

The heating system was put into operation one month ahead of the required month the first year to facilitate the drying out of the building. It is estimated that it took about 5000 gal. of oil for this purpose. It is noted that in the succeeding year less fuel is used. Additional radiation was installed in the penthouses the second year. A better fuel record was partly made possible through a more complete understanding and maintenance of the system.

[1]*Editor's Note:* An additional column would prove of value in some cases. This would show the fuel used per degree day, thus eliminating the variable of the weather. For example, in the above case, the total gallons of oil per degree day for each of the four years was 13.9, 12.9, 12.8 and 13.0, respectively, showing that the fuel consumption was quite consistent during the past three years.



CO_2 content of the flue gas, as recorded by the CO_2 meter, indicates that good operation is being obtained. If the figure drops much below 12%, reasons should be looked for.



An average flue temperature curve taken from the recording thermometer. Poor heat absorption is easily detected by rising temperatures.

A modern sub-atmospheric steam heating system is installed. An overhead piping arrangement is made from the 20th floor down to the fourth floor. The first three floors are heated with upfeed risers.

Boiler Operation

The firing of the boilers is started at 5 a.m. Steam at atmospheric pressure to 2 lb. is carried through the supply mains and is maintained for an hour during the heating-up period. Between 6 and 7:30 the steam pressure is reduced to atmospheric pressure or below, usually around 5 in. of vacuum at the steam supply mains.

After that the steam is circulated at sub-atmospheric pressures, ranging from 10 in. to 18 in. of vacuum. The latter figure is maintained most of the time throughout the greater part of the season. At 11 p.m. or 12 p.m. the oil burners are turned off for the night.

Cash Profits Through Modernization

THE "modernizing" wave that is sweeping the country is developing an exacting tenantry. To meet this, many thoroughly substantial buildings in good locations are deeming it necessary to modernize exteriors and remodel and redecorate lobbies and floors in most radical fashion. These outlays of cash will doubtless prove profitable in most instances, but good business, particularly in these days of tight money, demands that the building manager analyze most carefully the possible returns from each of various forms of modernizing, and spend his modernizing money where it will best manufacture cash profits.

Many managers keenly alive to the eye appeal of building exterior and interior decoration fail to realize the costliness of obsolescent equipment, yet this equipment (rarely seen by the manager and never by the tenant) may be the deciding integer in both profitable operation and tenant satisfaction and permanency. Any building erected ten or more years ago can decrease operating and maintenance costs and increase rental income by modernizing its mechanical equipment.

Here also careful analysis is necessary to determine what equipment will best manufacture cash profits through modernization. Modernity in lighting fixtures is selected by some managers because of the relatively small cash outlay involved, and because of a self-evident eye appeal. It must be remembered, however, that while this expenditure does give eye appeal value and has a measure of attractiveness for the tenant, it is not one that reduces operating and maintenance costs. Partial or complete modernization of the elevator plant, on the other hand, may in some cases, dependent on power used etc., manufacture cash profits through reduced operating costs. Too often the attention of the building manager is focussed on soaps, toilet supplies, the turning off of electric bulbs here and there, etc., etc., which while they are items to be watched, and watched carefully, are in the aggregate minor matters compared to the items named.

A type of equipment which offers outstanding opportunities for manufacturing cash profits through modernization is not receiving the attention it deserves, although its operation usually averages from 5% to 15% of the total operating cost, and an appreciable saving in operation would immediately be reflected in increased net profit.

We refer to the heating system. This all too frequently does not come into the analysis of modernization values, yet both because of its being one of the large items of operating (and maintenance) costs, and because of the period of time covered by the outlay, it really is a major value.

The neglect of so important a phase of operation and management is perhaps due to (1) the non-visibility of the equipment. It is hidden in the basement or subbasement and rarely seen by the manager. (2) Heating is an unfamiliar subject in which he has little or no training. It involves operations which do not come under his daily observations, as do other phases of his management, and he mentally sees these operations as something too technical for him, so he focuses his attention on visibilities that are part of his daily contacts.

It is well that this erroneous viewpoint and attitude is more and more being discarded, and that undreamed of profits are being manufactured today by managers who investigate, and act on, modernization of the heating plant.—*Oliver J. Prentice, in Heating and Piping Contractors National Association Official Bulletin.*

Making the Rounds with a SERVICE *Man*

By V. D. Milliken

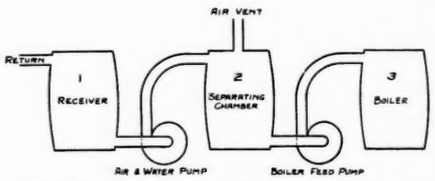
Doc White is the service engineer for a large contracting organization, and many of his problems have to do with troubles encountered with vacuum heating systems, especially those where the pump has been improperly selected or installed. McKay is his new assistant and Doc has been training him to handle work similar to his own. In this installment, Doc describes the different kinds of pumps.

Part VI

Doc and Mac, having followed up all the trouble calls which were reported to them, returned to the office.

"Well, Mac," said Doc, "do you find this sort of work interesting?"

"I sure do," replied Mac. "I have absorbed a lot of information about vacuum heating systems, but I am rather lame on the operating principles of the various types of vacuum pumps."



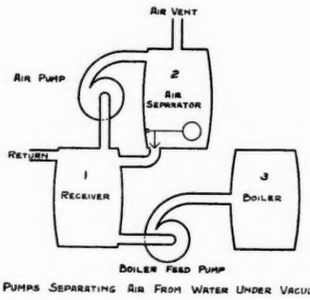
PUMPS SEPARATING AIR FROM WATER UNDER ATMOSPHERIC CONDITIONS.

"We'll go into that next. While I am dictating some letters, read this little booklet which describes all makes of vacuum pumps."

Doc left the room and Mac devoured the contents of the booklet greedily. When Doc returned he said, "Let's get down to business," and wrote the following classification on a sheet of paper:

1. Vacuum pumps separating air from water under atmospheric conditions.
   a. Water piston pumps.
   b. Stationary jet pumps.
   c. Rotary jet pumps.
2. Vacuum pumps separating air from water under a vacuum.

"Now, Mac, there are two general classifications of vacuum pumps, as I have noted. The easiest method to describe the difference between these two classifications is to draw three barrels. That is, on paper. I express myself in a clumsy manner occasionally, but in this instance, my clumsiness has started me wondering if Charlie, the originator of the barrel system, got his inspiration from drawing barrels on ice. Well, anyway, here are three barrels. Barrel number one represents the return line and receiver of the pump, barrel number two represents the air separating chamber, and barrel number three represents the boiler. Pumps in the first classification, which separate the air from the water under atmospheric conditions, operate in the following manner: Air and water are removed from barrel number one, in which a vacuum is maintained, to barrel number two, which is open to atmosphere. The air separates from the water in barrel number two and water is pumped from this barrel to barrel number three. Is that clear?"



PUMPS SEPARATING AIR FROM WATER UNDER VACUUM.

"Perfectly," replied Mac.

"Good," continued Doc. "The second classification covers pumps which separate the air from the water under vacuum. In this classification, separate air and water pumps are used. The air pump discharges the air and the surplus operating water from barrel number one, which is maintained under vacuum, to barrel number two, which is open to atmosphere. Barrel number two is equipped with a float-operated valve which opens as the excess operating water accumulates, thereby permitting this water to drain back into barrel number one. The water pump removes the water from barrel number one, under vacuum, and discharges it to barrel number three. When I stated that the latter classification of pumps separates the air from the water under vacuum, I was referring to the separation which takes place in barrel number one where most of the separation occurs. You will note that air is liberated under atmospheric conditions in barrel number two, therefore, strictly speaking, all of the air is not separated under vacuum."

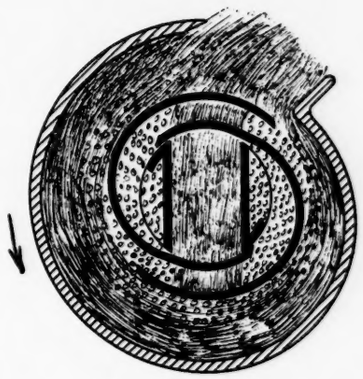
"Does it make any difference whether you separate the air under vacuum or under atmospheric conditions?" asked Mac.

"There are several ways to remove air from water," replied Doc, "just as there are several ways to skin a banana. The important point is to skin the banana properly regardless of the method."

"I now understand in general how the pumps work," said Mac, "but how do they produce a vacuum?"

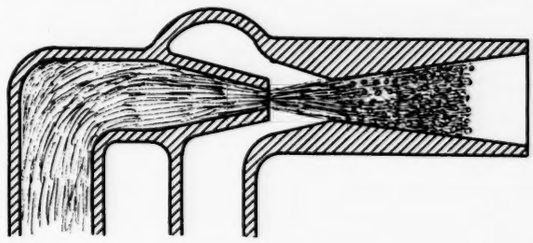
"The water piston pumps produce a vacuum by means of pistons of water which, relatively speaking, recede in cylinders, thus producing a vacuum behind the pistons. I say 'relatively speaking' because the pistons of water theoretically remain stationary while the cylinders move, thereby producing the same results as if the pistons were receding in stationary cylinders. The pistons of water remain stationary because they possess inertia. To demonstrate this, set a tumbler of water on a sheet of paper which is placed near the edge of your desk. If you jerk the sheet of paper very quickly, you will remove it from the desk but the tum-

bler of water remains unspilled on the desk because the paper does not impart sufficient force to the tumbler of water to overcome its inertia when jerked quickly. Now, take a short piece of small pipe and by holding it in a vertical position with your thumb over the bottom end of the pipe, fill the pipe with water. You now have a cylinder filled with a water piston. The water piston possesses inertia just as the tumbler of water possesses inertia. If you jerk the pipe vertically downward, the piston of water will remain relatively stationary and you will feel your thumb being 'sucked' into the pipe due to the vacuum created behind the piston of water. If you were to bend the pipe to conform to the arc of a circle, and then rotated the curved pipe about the center of the circle, you would have the same action because the piston of water would remain relatively stationary while the pipe or cylinder moved.



Water Piston Type

"Imagine several pipes bent and properly mounted to a rotating drum and you have a multitude of cylinders which, when filled with pistons of water, will each have the action of the single cylinder and piston. Very generally speaking, this is the construction of the vacuum-producing rotor of the water piston type of pump, except that the cylinders are all cast integral in bronze. In the sketch for this type of pump you will note that there are two curved cylinders shown diametrically opposite each other. The two cylinders constitute a deck and there are other decks superimposed and staggered so as to give the proper capacity and to produce an even suction. In order to provide stationary pistons of water for the many cylinders of the rotor, a device known as the post is employed. The post is a stationary bronze casting which is placed inside the revolving rotor. The post is divided into three compartments. The operating water, which forms the water pistons, enters through the center compartment. As the rotor revolves counter-clockwise to the position shown, it has cut off two water pistons. As the rotor continues to revolve, the action obtained is that of a piston receding in a cylinder, creating a vacuum behind it. This vacuum is manifested on the remaining two openings in the post, which are called the suction ports. Thus, the revolving rotor alternately admits the water pistons and uncovers the suction ports at the proper time.

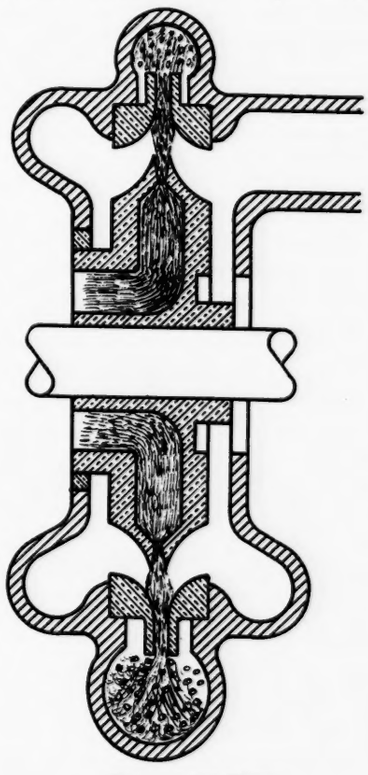


Stationary Jet Type

"The next type of pump in the classification is the stationary jet pump. This pump produces a vacuum by means of a stream of water forced through a nozzle under pressure which causes the water to break up, thus entraining air. The water and entrained air are discharged through a modified venturi tube into the separating chamber. A gap between the pressure nozzle and the mouth of the venturi tube permits air from the system to be drawn into the stream and thus entrained.

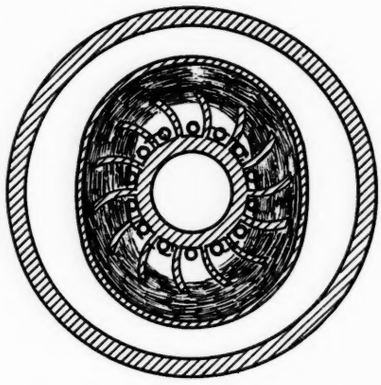
"The rotary jet type of pump works on the same general principle of entraining air, except that the jet is produced by a rotor, as its name implies. The rotor is similar to a centrifugal impeller with rings attached to the periphery and shaped to form a nozzle. Surrounding the rotor is a set of rings shaped to form a modified venturi tube. Between the rotor and the surrounding venturi tube is a gap, as is the case with the stationary jet pumps through which the air and water from the system are drawn. Operating water is discharged from the rotor in an annular screen which entrains air, and both are discharged through the circular venturi tube.

"The second classification of pumps, those which separate the air from the water under vacuum, also use water as an operating medium. We will call this pump the centrifugal displacement type. This type of pump employs a rotor which has many curved blades radiating from its hub. The rotor revolves in an elliptical casing, causing the operating water in the casing to revolve with the rotor. Due to centrifugal force, the rotating water follows the contour of the elliptical casing, and in so doing, alternately diverges from the recesses between the blades of the rotor as the individual portions of water approach the long axis of the elliptical casing, and then are forced into the recesses as the portions of water approach the short axis of the ellipse. Now, take one of these portions of water and follow it through its cycle, remembering, of course, that all the other portions or slugs of water are doing likewise in their turn. As a portion of water contained in the recess between any two blades approaches the long axis or wide part of the elliptical casing, it is gradually receding from the center of the rotor and, consequently, from the recess between the blades, thus creating a vacuum behind it. Ports are uncovered at the proper time and the vacuum which was produced causes air to rush into the rarefied space behind the water. When the portion of water passes the long axis and approaches



Rotary Jet Type

the short axis or narrow part of the casing, the elliptical contour of the casing forces the swiftly moving water into the recess between the blades, thus compressing the air which was previously admitted. Exhaust ports are uncovered and the air is forced out. The action, therefore, is analogous to a piston receding in a cylinder, drawing in air on the suction stroke, and discharging it on the exhaust stroke. This type of pump does not have valves, however, as does the reciprocating pump. Suitable holes are drilled between the blades near the center or hub of the rotor through which the air passes as the holes communicate with the intake and exhaust ports. The ports are elongated openings in a stationary port plate near which the rotor revolves without touching the port plate. In the sketch, you will note that I have indicated the ports in their approximate positions by dotted lines."



Centrifugal Displacement Type

"I believe that I will understand more thoroughly what is taking place within the various types of vacuum pumps, now that you have explained them to me, Doc," said Mac. "By the way, I'm glad I haven't been in the selling end of the pump business for the past year or so. It must be pretty slim picking when business is so dull."

"You said it," said Doc. "One trouble is that to get the business prices are cut below a point where a legitimate profit can be made. That reminds me of a bedtime story I heard recently. The title of the story is 'How a donkey became known as an ass.' The story goes something like this. Once upon a time there was a wise man who wished to cross the mountains. Knowing that he must employ a donkey to carry him over the long and treacherous road, he walked out into the fields until he came upon a donkey. He said to the donkey, 'How much will you charge to carry me over the mountain?' Whereupon the donkey replied, 'Six bales of hay, sir'. Just then another donkey stepped up to the wise man and said, 'I'll do it for five bales of hay'. The first donkey, believing that he would lose his customer said, 'I will do it for four bales of hay'. Again the second donkey addressed the wise man and said, 'I will carry you across the mountain for three bales of hay.' A frown darkened the wise man's face as he stroked his beard. Presently he turned to the second donkey and said, 'You fool, you know you cannot exist on three bales of hay. You are an ass'. So from that time up to the present day, the donkey has been known as an ass."

States and Cities Consider Low Cost Housing and Slum Clearance

STATES and cities are moving to expedite low cost housing and slum clearance with the aid of the Reconstruction Finance Corporation, according to the American Engineering Council. A national movement to encourage state action is gaining ground, and the disbursement by the Corporation of hundreds of millions of dollars to promote self-liquidating enterprises of this character seems assured, says a statement by the Council, which is cooperating with the Corporation in an effort to accelerate the granting of loans involving the field of engineering.

New York, by establishing a State Housing Board, is the first to comply with the provisions of the Emergency Relief and Construction Act under which the Corporation can make loans to "corporations formed wholly for the purpose of providing houses for families of low incomes, or for reconstruction of slum areas, which are regulated by state or municipal law as to rents, charges, capital structure, rate of return, and areas and methods of operation."

The non-existence of an appropriate local regulatory authority, save in New York State, is the chief barrier to the financing with Federal assistance of a huge housing program employing large numbers of men and a vast amount of materials. Concerted effort by engineers, architects, the building industry, and civic groups is gradually surmounting this difficulty, and the release of funds, soon to begin, is expected to acquire a momentum which will influence business revival.

Ohio, Illinois, Massachusetts, Indiana, and Pennsylvania have organized committees to bring about legislative action which will enable private building corporations to borrow from the Corporation. Chicago, Cleveland, Cincinnati, Boston, and Washington, D. C., in addition to New York City, are centers of this activity.

The first loans for housing and slum clearance will undoubtedly be made in New York. In addition to projects already tentatively approved by the New York State Housing Board entailing the expenditure of $59,000,000 and calling for a loan of approximately $40,000,000 from the Reconstruction Finance Corporation, for which application has already been made, other New York projects of about equal amount are taking shape, and probably will be presented to the Corporation with applications for loans.

This situation indicates the large possibilities for industrial recovery inherent in the housing aspects of the Emergency Act. Congress imposed no limit on the funds which might be allotted to these and other self-liquidating projects.

The legislatures of Illinois and Ohio are now in session, and, it is believed, will pass legislation creating regulatory bodies to meet the requirements of the Emergency Act. The movement for legislative action in Illinois is directed by Alfred K. Stern, director of special activities of the Julius Rosenwald Fund.

Fabricated Houses Open New Possibilities in Home Building

WHILE production methods have been applied to almost every conceivable manufactured product, nevertheless, the erection of residences has remained a handmade affair. Perhaps no other important industry has been so backward about adapting factory methods as has that part of the building industry concerned with the smaller buildings.

Many believe that such backwardness has been quite detrimental, not only from the standpoint of the manufacturers of building supplies and the building trades themselves, but to society in general. Hand labor is expensive, and while the desire for home-ownership is so deeply rooted as to be almost instinctive, the high cost of homes has carried the pleasure of home owning out of the realm of possibility for very large numbers. It has resulted in the deplorable congestion and unhealthy living conditions found in some quarters in every large city.

Two distinctly different ways of applying factory methods to home building have been proposed to reduce the present high cost of dwellings. One method is to build standardized houses in the factory, a sufficient number of models being available to satisfy the majority of prospective buyers. The second method is to standardize *parts* so that buildings of entirely different type and appearance can be erected from the standard parts.

The completely standardized house would have both advantages and disadvantages. An announcement some months ago of the formation of a corporation which will engage in the design and fabrication of factory-built houses was greeted both by enthusiastic comments and by no inconsiderable disapproval. While the company is reported as progressing with its plans, nothing concrete has as yet been announced.

The idea of a house built of standardized parts, has, however, made considerable progress. For some reason, Cleveland seems to have been the city selected for the erection of experimental houses being worked out by as many different companies. Two of these are far enough along to excite keen interest among builders. The heating industry will watch the work closely to determine along what lines the heating will be carried out, for it is not improbable that the developments in Cleveland will have far-reaching effects on the manufacturer of heating equipment, the heating contractor, his steamfitters, and sheetmetal workers.

One of the experimental houses was designed and erected by Insulated Steel, Incorporated, and manufactured by The American Rolling Mill Company. Another, recently completed, is that of The Ferro Enamel Corporation. The former, erected in Solon, a suburb of Cleveland, has received considerable publicity as the "frameless steel house," while the latter job uses enameled steel shingles to cover the walls. The walls are made of the Truscon Steel Company's Ferroclad, which consists of insulation between two steel sheets. A third home, opened to the public during October, is that of Homes Permanesque of America, built to sell with its site complete for $5500. This building is made up of factory-built panels, the exterior finish of which is applied in the factory. The panels are of rigid asbestos, resembling thin stone, back of which are dead-air and air-cell asbestos spaces. The panels are applied to a steel frame fastened together with steel wedges.

The walls of the Solon house, of 20-gauge steel sheet, support the building so that it requires no frame. Channels 2 in. deep and 6 in. wide are pressed lengthwise in the sheets to give them strength. After forming, these wall sheets are of four different standard widths, providing a certain amount of flexibility and width adjustment in assembly walls. Further adjustment is secured by telescoping the channels.

The walls were assembled in large sections, room wide and story high, with window or door frames in place. The welding of the various pieces in a section is quickly done. The welds are approximately 3/8 in. long, spaced about 12 in. apart, and require on the average 5 sec. time per weld. The complete wall weighs slightly more than 2 lb. per sq. ft.

In erecting the house, the lower floor was completed first. Then, the first story walls were set in place and welded to a foundation cap and the floor. The second floor was next completed, followed by the second story walls, the roof, and the parapet walls. As it was erected a floor at a time, no scaffolding nor extension ladders were necessary. The union of the steel floors and walls was accomplished by arc welding. One welding outfit and two workmen were employed on the erection work.

Heavily insulated, the exterior of the house is covered with porcelain enameled shingles. It is expected that it will never require painting, and a bath with a garden hose will restore its luster.

The heating system of the Insulated Steel, Incorporated, house consists of an oil-burning warm-air furnace with runs of flat duct with 7-ft. headroom. Warm-air risers and cold-air returns for the second floor involved a major problem because the sheet steel walls, by the nature of their design, do not provide space for such apparatus. The channels in the wall sheets have a depth of 2 in. and a width of 6 in., wholly inadequate for air ducts.

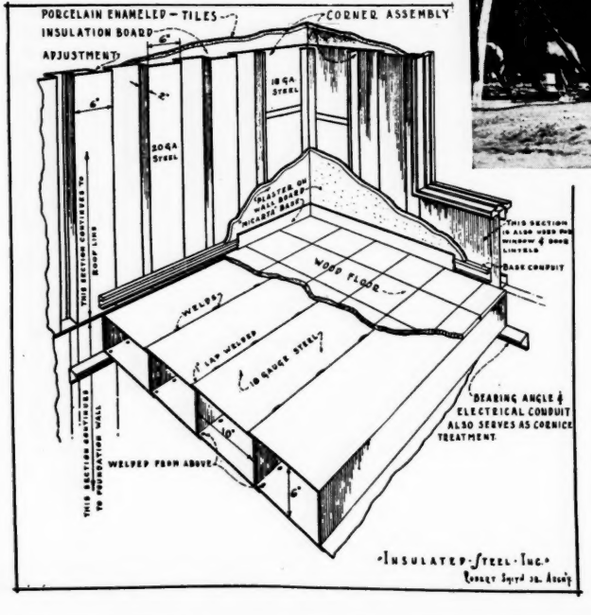
The question has been asked why the wall channels themselves are not used for ducts. As they are now designed, the channels do not lend themselves to such use, principally because it would complicate the production and erection of the sheets in the standardized form, upon which the originators based their hope for econ-

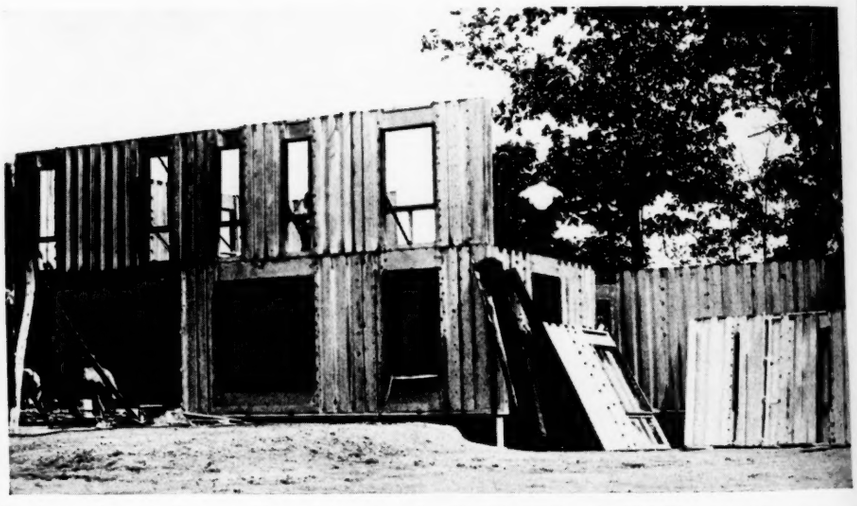
IS THE MACHINE AGE

For the first time, quantity production methods are being applied to the production of houses. The idea of using factory methods in the production of fabricated units may revolutionize practices in the building industry.

Above—The glare of the welder's torch lights the factory in which the wall sections of the Solon house are being assembled. Right—Assembling the floors on the Solon house foundation. When welded together these Z-sheets form a series of connected metal boxes of great strength.

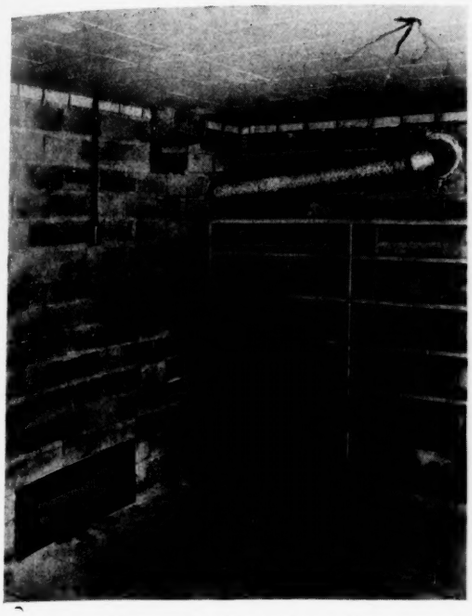
The construction detail of the Solon job, shown below, illustrates clearly the use of the Z-sheets for the floor. The walls are covered on the exterior with enameled shingles, with a liberal use of insulation. The heat loss through the finished wall is in the neighborhood of 0.09 B.t.u. per sq. ft. per hr.



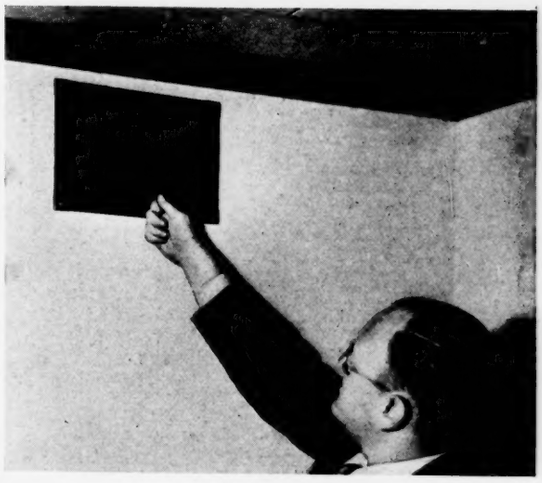


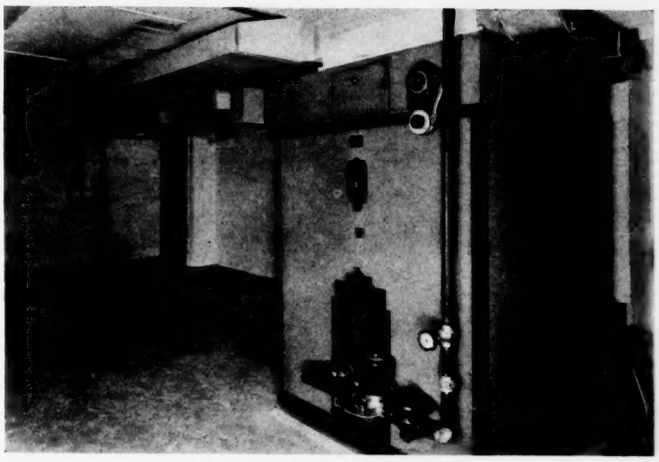
After 156 hours of field labor the "chassis" of the Insulated Steel house nears completion. The exterior will then be insulated and the porcelain enameled shingles applied. The fabricated units, as received from the factory, can be seen to the right.

CATCHING UP WITH HOME BUILDING ?



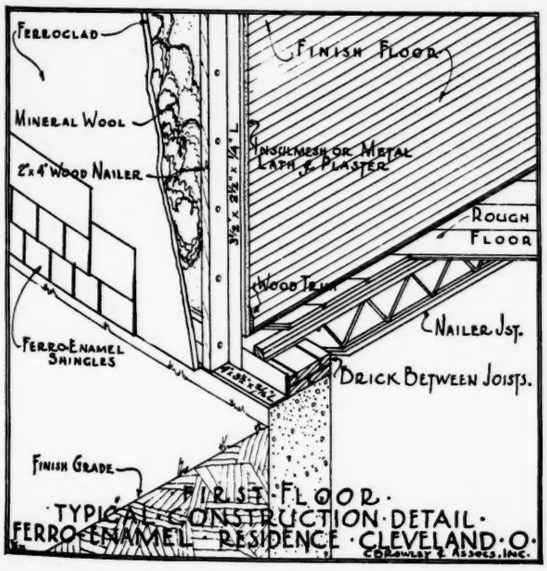
Right—In the Solon job, the warm-air registers in the upstairs rooms are located near the ceiling and supplied by an overhead duct running horizontally across the hallway to a shaft between the two bathrooms. The shaft carries all pipes and ducts to the second floor.

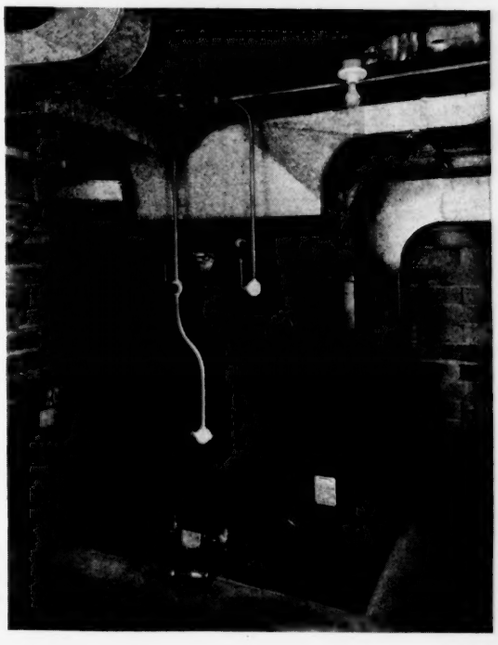




Above—Cold air from the second floor of the Insulated Steel house at Solon drops down the stairwell and is taken through a register between the foot of the stairs and the front door, and from there down to the basement recreation room. It is exhausted into one side of this room, as shown, and taken directly into the furnace from the other side. Right—The gas-fired warm-air furnace in the Ferro Enamel house. Note the well-planned and workmanlike ductwork.

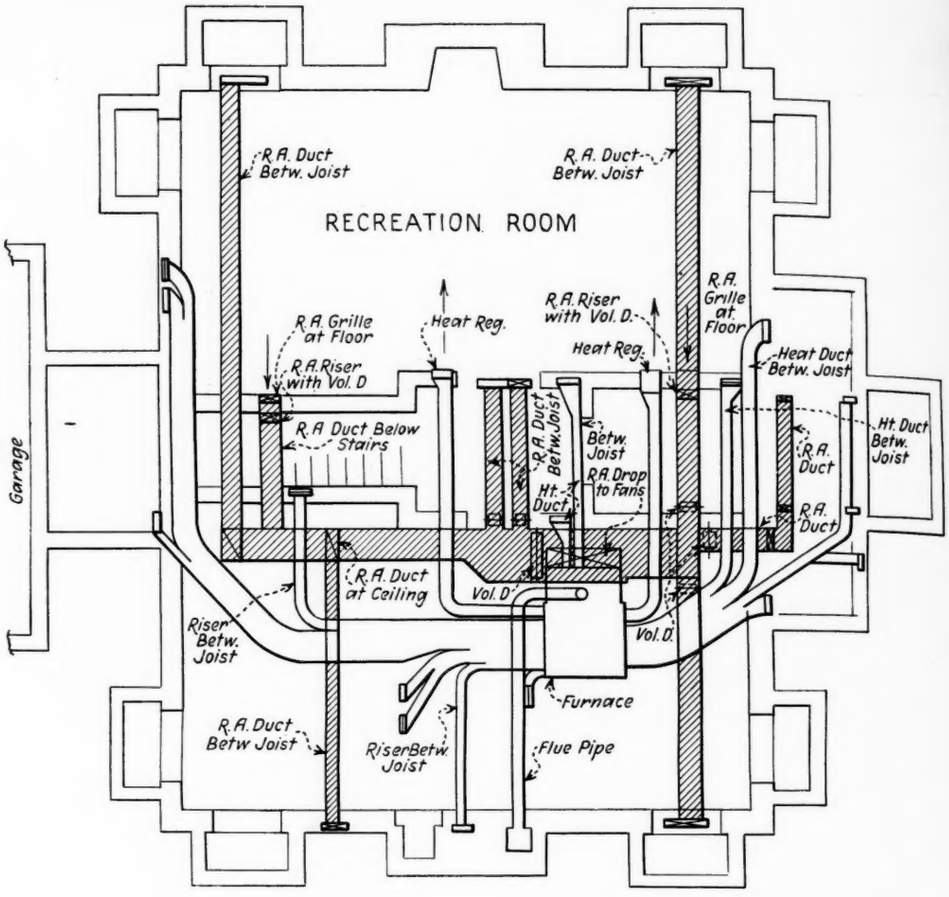
Mineral wool is used in the Ferro Enamel house walls, a detail of which is shown below.

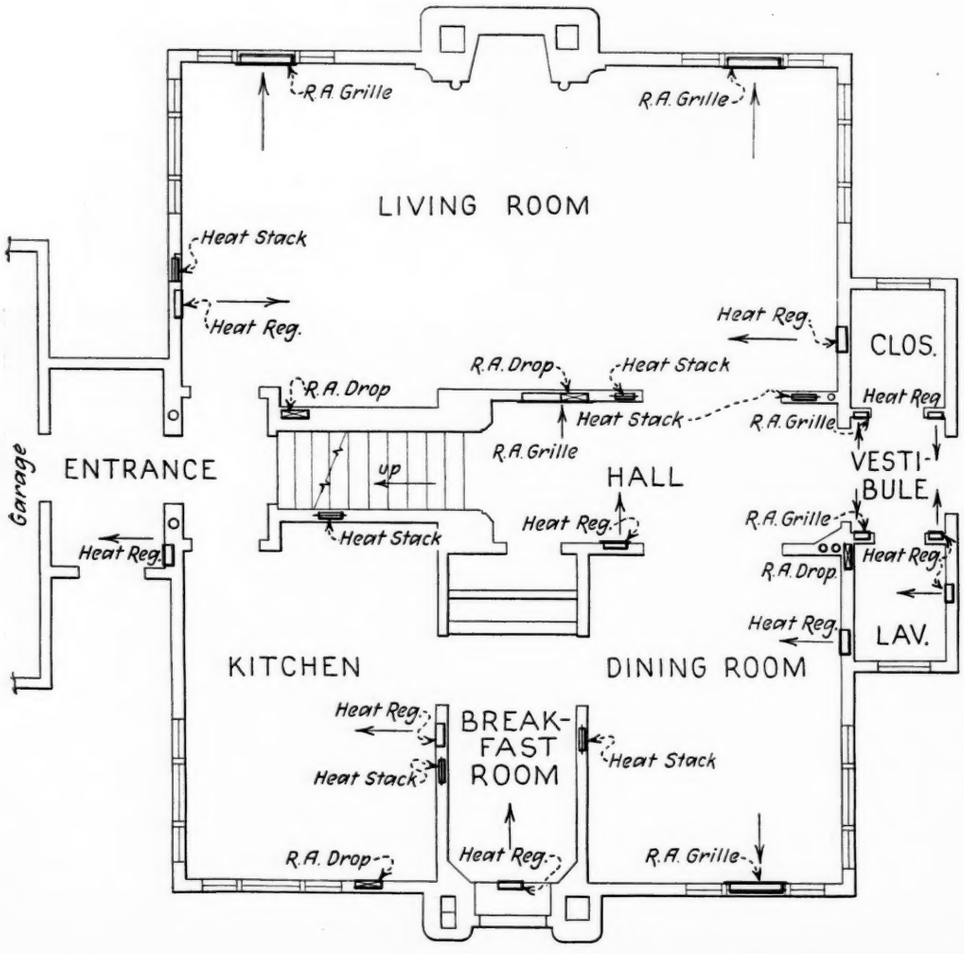




Right—Front view of the furnace in the Solon house. Cold-air ducts are shown at the right.

Plan of the heating layout for basement of Ferro Enamel house. Split dampers are placed at each branch of main heat duct.





KEY

VOL. D.—Volume Damper
R.A.—Return Air
HEAT REG.—Heat Register
RETURN AIR DUCTS SHADED

Plan of heating layout for first floor of Ferro Enamel house. The walls are made of steel plates, 1/2 in. of Celotex, and 4 in. of insulation with metal lath and plaster. The heat loss coefficient is 0.09.

omy and speed in construction. Another reason why the channels cannot be used is due to the excessive heat loss through the steel wall.

The problem was solved by carrying the ducts for all second floor rooms up a small shaft, which is also utilized to bring the water pipes, drain pipes and electric conduits to this floor. Owing to the beamless steel construction of the floors, it was not possible to carry ducts horizontally from the shaft to the bedrooms at the floor level. To meet this condition, registers were placed in the bedrooms and one of the bathrooms just below the ceiling.

Due to the compactness of the second floor plan, the engineers agreed that the stair well to the first floor was more than adequate to carry the return air. At the foot of the stairs, and just inside the front door, two cold-air registers are located. One of these is connected by a direct duct to the cold-air intake of the conditioning unit on the furnace. The other enters the recreation room in the basement through a register in the wall at the floor line. The cold air then is taken off the floor of the recreation room directly into the furnace intake through a register in the wall at the floor line, about 15 ft. from the other register.

Warm-air registers for the first floor rooms are installed in the floor near the wall line, and cold-air returns from the living and dining rooms also are through the floor.

The furnace has two complete combustion chambers linked together by a radiator leading to the stack. A full set of controls is provided for each of the units, so that one side can be shut off while the other continues to operate on mild days.

The air conditioning unit of the furnace is compact and simple. It is equipped with a blower, driven by a capacitor motor and four 16 in. x 25 in. air filters. The humidifier can evaporate 60 gal. per day.

Construction details of The Ferro Enamel Corporation house are shown in the accompanying illustrations, the heating layout also being shown, while the exterior is shown on this month's cover illustration. The heat loss through the walls of this building is approximately equivalent to that through a 24-in. brick wall. The heat input to the system is 150,000 B.t.u. per hr., as compared with an output of 147,575 B.t.u. per hr. for the Insulated Steel, Incorporated, house.

The steel frame of the Ferro Enamel house is of 4-in. channels and is similar to the ordinary wood frame except, of course, that there are fewer studs. The siding is of fibre insulating board sandwiched between two steel sheets, covered on the outside with porcelain enameled shingles. The shingles are of 20-gauge steel. For erecting, they are vulcanized to roofing felt, and nailed to the Ferro-Clad in strips of six.

The shingles on the side walls are of a deep sandstone shade, with rich brown over-spatter. Trim and contrast are provided by a band of blue-green shingles around the base, and another band of the same color just under the coping. The roof is in three shades of russet, blended to give a pleasing mottled effect. A matte or dull-finish enamel has been used, instead of the glossy finish ordinarily seen on ranges and other household products.

The style of the house is modified English Georgian, the severe lines of which give a strikingly modern effect. The garage is attached directly to the rear of the house, and the garage roof has been made a combined porch and terrace, with provisions for screening in summer and glass-enclosure in winter.

Much of the preliminary work of this house can be done in the factory. The frame, windows, and sheathing were pre-fabricated in the factory of Truscon Steel Company. Erection was begun on July 8. It required about five working days to complete the frame and apply the insulation. The steel shingles, which were made in the plant of the Vitreous Enameling Co., Cleveland, were applied to the walls of the house and garage, and also the roof, in five days. The total time for erection was less than half that ordinarily required for similar type constructions made in the conventional materials.

The oil-fired furnace for the Solon job is that of the Perfection Stove Company, Cleveland. Engineers of this company, together with those from the Warm Air Furnace Fan Company, designed the heating system. The Ferro Enamel house has a Surface Combustion Heatmaster gas-fired furnace. Other apparatus in the Solon house includes a Miles blower, Ohio capacitor motor, Detroit solenoid valves and room thermostat, Mercoid fan control and limit control, and Uni-flo registers and grilles. Grilles of the same make are used in the Ferro Enamel house.

Charles Bacon Rowley is the architect of the Ferro Enamel house, while Mannen & Roth were the engineers and contractors. Robert Smith, Jr., was the architect of the Insulated Steel, Incorporated, house. Cutter Sheet Steel and Manufacturing Company installed the sheet metal work, which was unusually fine, in the latter house.

The lumber interests have not been inactive in the matter of fabricated houses. The engineering department of the National Lumber Manufacturers Association has completed plans for a five-room, one-story dwelling, 24 ft. x 36 ft., composed of 150 fabricated sections. These plans are now under advisory consideration as to their practicability and probable popularity by a dozen representative lumber retailers and as many manufacturers in different parts of the country.

The plans are so worked out that the parts can be built in any retail yard or millwork plant which has the necessary facilities. Erection of the house consists merely in assembling the sections on the building site. The framework is not segregated from the walls. In other words, the house is literally built up from blocks. The sections or panels are completely equipped with doors, window screens, blinds, and other accessories.

The dwelling will have no basement, but a heater room with a fuel storage space is provided on a level about 2 ft. below an opening off the kitchen. If hot water heat is preferred, the panels will provide for concealed radiators. The cost of this manufactured dwelling is estimated at about $2,500.

The exterior finish may be of siding, shingles, or stucco; and it, the porch and cornice work and the finished floor are to be applied subsequent to assembly of the panels. The interior of the house will be entirely finished in sawn inch-lumber, which may be painted or finished in natural colors and may be of any species desired by the manufacturer or purchaser. Wall, floor, and ceiling panels will be heavily insulated.

Abstracts . . .

Reviews and Summaries of . . . . Current Papers, Books and Pamphlets

Removal of Soot from Furnaces and Flues by the Use of Salts or Compounds

By P. Nicholls and C. W. Staples

Bulletin No. 360, Bureau of Mines; obtainable by addressing Superintendent of Documents, Washington; 6 in. x 9 in. page size; paper bound; illustrated; 76 pages; price, 10 cents.

Report of an investigation conducted by the bureau during which tests were made using various compounds, including salt, and both laboratory and plant tests were made.

Bulletin states that "The main object of the investigation covered by this report was to determine whether there was truth in the popular belief, and whether the compounds sold accomplished any part of what the makers claimed. If the applications were found to be effective in any degree there were the secondary objectives of determining their limitations as fixed by the fire and furnace on which they were used, and the conditions under which they were applied; also of determining the relative effectiveness of various salts, materials, or mixtures, and the manner in which they act."

One of the interesting passages occurs under the head of "What the Householder Should Know About Soot Removers," as follows: "The action of soot removers is to produce conditions so that the soot will ignite at a lower temperature and burn more easily. There is none of that magic action which is often implied in the advertisements and on the packages. The effectiveness of the burning varies with the composition of the remover, but is also largely a matter of chance of the conditions being favorable. They will usually produce at least some reduction in the soot in the furnace and flue pipe, but their action does not often extend to the chimney. This ash not only does not burn, and must be removed by hand as before, but it also prevents complete burning of the soot mixed with it.

"Since the action is that of causing the soot to burn, there are the same fire hazards as from ignition of the soot by other means. Vigorous burning of soot in the flue pipe or chimney always involves a risk unless the flue pipe and chimney are properly installed or constructed, and are kept in good repair. The correct and most thorough method of cleaning out is to do it manually, or to employ the more modern exhaust or vacuum method. However, not many householders can remove soot and ash accumulations thoroughly more than once a year, so that if deposits of soot accumulate quickly and interfere with proper operation of the stove or heater, a soot remover may help to keep the passages clear enough between thorough cleanings to maintain satisfactory operation of the furnace."

Among the conclusions listed is one dealing with the experience found when using the compounds in household heaters, viz.; "Good, but rather uncertain, success was obtained with household heaters; it was better as the deposit of soot was thicker. The action extended further in warm-air furnaces because the gases leaving the furnace could reach a high temperature, so that the soot in the flue pipe and sometimes the chimney would burn. In no installation did burning of the soot in the chimney occur with heating boilers. The burning of a small amount of wood and paper after the treatment insures more thorough burning of the soot and extends the action further."

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Loss of Head in Copper Pipe and Fittings

By F. E. Giesecke and W. A. Badgett

Paper presented at the Milwaukee meeting of the A.S.H.V.E., June, 1932; illustrated and with curves showing results; result of a research carried on at Texas A. & M. College in cooperation with the society laboratory; approximately 2000 words.

The authors used a test set-up whereby water at a constant temperature and under a constant head could flow through a pipe line. The loss of head was measured by piezometer rings. Tests were also made to find the loss of head due to elbows and tees. Tests were made on pipes and elbows of ¾ in., 1 in., 1¼ in., and 1½ in. diameter, and on 1 in. tees.

Formulas are given for computing the loss of head (with 84° water) for copper pipe, elbows and 1 in. tees.

●

Corrosion in Dehumidifiers

By M. M. Schlissel

From "Universal Engineer," July, 1932; approximately 2000 words; no illustrations.

Outlines factors entering into corrosion of metal parts of air conditioning equipment.

Iron goes into solution in contact with water by displacing some element already in solution. Dissolved hydrogen is displaced by iron, and is deposited in a thin film, retarding further corrosion. This hydrogen is removed by reacting with dissolved oxygen, or it may escape as gaseous hydrogen.

An important factor controlling the rapidity with which iron is attacked by water is the H-ion concentration. Neutral conditions prevail at a concentration of 7, above 7 the solution is alkaline, and below 7 it is acid.

Water used in air conditioning processes naturally is in contact with the air, and from it takes into solu-

tion oxygen and carbon dioxide. Carbon dioxide accelerates corrosion. An alkaline solution will cause less corrosion of iron than a neutral or acid solution, but it is seldom that the water supplied is alkaline, and after use for a short time becomes acid from dissolved impurities in the air.

Some protection is obtained by addition of alkalines to water, but care must be exercised in their use. Concentration should not be less than 10 for iron. Where zinc is used, either in galvanizing or as such, it is subject to attack both at high and low concentrations. A product has been evolved to bring about passivity by maintaining the proper concentration, and protects by a built-up film (Vaporine).

Corrosion also takes place by galvanic action set up when two dissimilar metals are immersed in an electrolytic solution.

An analysis is presented to show the condition of water upon being placed in a dehumidifier, as compared with the same water at the end of four days. The raw water showed positive ion concentration of 7.2, and at the end of four days the concentration was 4.1. The acidity at 4.1 is 1100 times greater than at 7.2.

●

Noise Abatement by Construction Parts

From "Uber den Schallschutz durch Baukonstruktionsteile." by Dr. Ing. H. Reiher; Beiheft zum Gesundheit-Ingenieur, No. 11, Series II, 1932; 28 pages.

ABSTRACTED BY A. A. BERESTNEFF

Records the results of tests carried out by the Institute for Investigating Noise and Heat Transmission, Stuttgart, to determine the noise insulating capacity of over 200 different types and materials of construction. Observations were made in houses, in the laboratory, and in the special test house of the institute. The following conclusions are reported:

1. In a homogeneous wall the noise insulating capacity increases with increase of the sound frequency. While the increase is not great, it is better to use the middle value for calculations.
2. In a homogeneous wall the noise insulating capacity S may be represented accurately enough by the equation

   $$S = 32.3\ G^{0.2}\ \text{decibels},$$

   where G is the density of the material in pounds per cubic inch. This means that with an increase of weight of 100% the insulating capacity increases about 15%.
3. For a wall consisting of several layers in close contact, the same relation as that found for homogeneous walls is applicable; i.e., the insulating capacity increases about as the 1/5 power of the weight, which means that any added layer is much less effective than the preceding one.
4. Insulating capacity of thin, rigid wall layers is greater than that of less rigid walls of the same weight.
5. Air spaces are effective as insulators if both limiting parts of the wall do not have any contacts. If good results must be obtained the thickness of space should not be less than 1.6 in. to 2 in. Any increase of this separation increases the noise insulating capacity but little.
6. Effectual damping of footstep sounds by ceilings depends upon the application of shock absorbing materials or insulating layers.
7. The reason for the often observed ineffectiveness of windows as noise insulation—especially double windows—is the unsatisfactory tightening of the grooves.

The writer also gives the minimum requirements regarding insulating capacity for the different parts of a structure as tabulated in the accompanying table. For such buildings as theaters and the like the requirements should be made higher.

MINIMUM REQUIREMENTS OF NOISE INSULATING CAPACITY

Parts of Structure	Required Minimum Noise Insulation in Decibels	
	Normal Cases	Unusual Cases, Such as Theaters
Outside walls	60	60
Inside walls between apartments	60	65 to 70
Inside partitions in hospitals, hotel rooms, etc.	—	60 to 65
Inside partitions between apartment rooms	30	40
Construction of ceilings		
Insulation against the noise transmitted through the air	60	70
Insulation against the sound of footsteps	40	30
Windows	25	40
Doors	30	50 (Double doors)

Tables are also included giving the values of the noise insulating capacity for more than 200 different types of construction.

●

Cooling and Air Conditioning for Comfort

By William Goodman

Published by Aerologist Publishing Co., Chicago; paper-covered; 6 in. x 9 in.; 96 pages; illustrated; price $1.50.

A thorough discussion of the theory and calculations of air and heat quantities for air conditioning, presented from a mathematical method of approach. The whole subject matter is analyzed in a fashion which is new to the published information. After reading some of the piecemeal discussions which have appeared, the author's comprehensive treatment is especially outstanding.

The style is readable and the mathematical work is so simple that it is easy to follow. After developing an equation, the author explains it in words and stops to draw generalizations when they occur.

The most notable feature of the author's treatment is his use of the ratio of the sensible heat to the total heat. Others have used ratios of a similar character but the author systematizes his use of it and examines the limiting cases, arriving at convincing conclusions.

Your Everyday Problems

Conducted by FRED W. HANBURGER

Mr. Hanburger will be glad to answer your problems relating to installation and operation of heating and ventilating systems, and wherever possible will give the reasons for his suggestions. Letters will be answered direct to the inquirer and in some cases published anonymously. If sketches are included they should be clearly drawn. Write Mr. Hanburger, HEATING AND VENTILATING, 148 Lafayette Street, New York.

ANSWER TO R. R. S. There is no close relation between mechanical and boiler horsepower. They are only second cousins, where the relationship may be traced through the mechanical value of 1 B.t.u. being equal to 778 ft.-lb. when it would take

$$\frac{33{,}000}{778} \times 60 = 2546 \text{ B.t.u.}$$

to make a horsepower-hour. The relationship, however, is still meaningless.

The definition of the boiler horsepower is the capacity to raise 34.5 lb. from and at 212° F. and a boiler horsepower-hour would be this amount in 1 hr. of time. The latent heat of 212° steam is 970 B.t.u., and as 1000 B.t.u. will supply roundly 4 sq. ft. of radiation, we can say that

$$\text{1 boiler hp.} = \frac{34.5 \text{ lb.} \times 970 \text{ B.t.u.}}{1000} \times 4 \text{ sq. ft.}$$
$$= 132 \text{ sq. ft. of cast iron radiation.}$$

●

The following question appeared in the June issue of HEATING AND VENTILATING, at which time answers from readers were solicited.

QUESTION 58. I understand that it is an established fact that an open gas flame burning to complete combustion in a room, consuming a definite amount of gas, must evolve a definite amount of heat. Now, why will this same burner, if surrounded by a casing (as in a gas stove or where used in connection with a gas steam radiator), burning exactly the same amount of gas and generating the same amount of heat, prove more effective in heating the room than will the open burner? There has been no heat lost. We may say that the heat is more evenly distributed, but that would indicate a concentration of heat somewhere. Where is it?

B. H. J.

ANSWER. A number of varied opinions were received, many of them failing to take into consideration all of the conditions specified in the statement of the problem. The true reason for the improved heating effect of the burner when surrounded by a casing, as brought out in several of the answers, lies in the manner in which the heat from the flame is transmitted. A great part of the heat from the open flame is radiated directly to the walls of the room from which it is immediately dissipated to the outside air by conduction. As radiant heat is not effective in warming a room until it impinges upon some surface, the air in the room is not perceptibly heated. If the open flame burns in a room crowded with furniture, the air will show a higher temperature due to the fact that each object intercepts a portion of the radiant heat and gives up heat thus absorbed to the air by convection. Therefore, if the flame is completely enclosed this radiant heat is absorbed by the various heating surfaces and transmitted throughout the room by conduction and convection.

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QUESTION 59. What is the maximum additional water vapor that can be contained in 1 lb. of the following gas:

Dry bulb temperature	234°
Moisture per pound dry gas	512 gr.
Density	0.068 lb. per cu. ft.
Analysis, per cent by volume—	
Carbon dioxide	8.2
Oxygen	11.2
Nitrogen	80.6

Please also give the method of solution and reference on the subject. *L. S. N.*

ANSWER. It may contain one million grains, a billion, or an infinite number. At a temperature above 212°, it is no longer a question of how much vapor the gas can contain, but rather how much gas the steam contains. As you have asked me to give the method of solution and to bring out the thought more clearly, let us first determine the amount of moisture the gas will hold at, say, 100° and then at 200°.

As the amount of moisture depends on the space alone that 1 lb. of the gas occupies, it is first necessary to determine either its density or its specific volume.

From the law in chemistry that all gases at the same volume and pressure contain an equal number of molecules, we may take the molecular or combining weight of the component gases and comparing it to some gas whose density we know, determine the weight of the gas in question.

The molecular weight of oxygen, O_2, is 32; of carbon, C, 12; of nitrogen, N_2, 28.

Air, whose properties we know, is composed of 20.9% by volume of O_2 and 79.1% by volume of N_2, so that its molecular weight must be:

$$\frac{0.209 \times 32 + 0.791 \times 28}{100} = 28.83$$

The molecular weight of carbon dioxide, whose symbol is CO_2 will be

$$12 + 32 = 44$$

and it must be

$$\frac{44}{28.83} = 1.52$$

times the weight of air, while that of oxygen is

$$\frac{32}{28.83} = 1.11$$

greater and nitrogen must be

$$\frac{28}{28.83} = 0.97 \text{ of the weight of air}$$

Taking the per cent of the volume of these gases into consideration the specific weight of the sample, as referred to air, will be:

$$0.082 \times 1.52 + 0.806 \times 0.97 + 0.112 \times 1.11 = 1.03$$

The density of air at any temperature may be determined by dividing its absolute temperature into the constant 39.67. The density of the sample then at 100° will then be:

$$\frac{39.67}{560°} \times 1.03 = 0.0728$$

and the volume for 1 lb. of the gas will be:

$$\frac{1}{0.0728} = 13.74 \text{ cu. ft.}$$

at a pressure of 14.7 lb. per sq. in.

If we inject vapor into this fixed space it would increase the pressure. But since pressure remains the same, the volume must expand. From the steam tables we find that steam at 100° has an absolute pressure of 0.946 lb. per sq. in. The pressure of the gas can thus be only

$$14.7 - 0.946 = 13.754 \text{ lb.}$$

The volume of 1 lb. of dry gas and its vapor will then be:

$$\frac{14.7 \text{ lb.}}{13.754 \text{ lb.}} \times 13.74 \text{ cu. ft.} = 14.7 \text{ cu. ft.}$$

We, therefore, have 14.7 cu. ft. of 100° steam in 1 lb. of dry gas. Referring to steam tables we find that the volume for 1 lb., or 7000 gr., is 350.8 cu. ft., giving

$$\frac{7000}{350.8} = 20 \text{ gr. per cu. ft.}$$

In 14.7 cu. ft. or 1 lb. of dry gas we will then have:

$$20 \text{ gr.} \times 14.7 \text{ cu. ft.} = 294 \text{ gr.}$$

to 1 lb. of dry gas.

A calculation made exactly in a similar manner for 200° gas will give 15,570 gr. of moisture per pound of dry air. The weight of the vapor is more than double that of the air and the ratio increases very rapidly as it reaches 212° when in reality it can be all steam at atmospheric pressure.

The gas in question, no doubt, is a flue gas where the steam at the base of the chimney could have a pressure of 14.7 lb. plus the friction in the flue. At the outlet, the pressure would be nearly atmospheric and the steam will have superheat. The more gas we now introduce, the less pressure will the steam have and, consequently, the greater will be the superheat.

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QUESTION 60. We are heating domestic hot water by means of a submerged heater installed in an oil-fired steam heating boiler. This has given excellent results during the heating season, but in the summer when it is necessary to maintain the boiler water at about 180°, *to avoid the formation of steam in the system, the temperature of the tap water seldom is higher than* 105°. *It is my understanding that there are many similar systems giving satisfactory service, and I would like to know the reason for failure in this case.*

M. C. & Co.

ANSWER. The trouble is not with the boiler or oil burner, but is probably due to the fact that the submerged heater is of correct capacity to supply hot water during the heating season when the water in the boiler is at or above 212°. Since the rate of heat transmission from the boiler water to the water in the submerged heater is proportional to the temperature difference existing between them, the water in the heater will not be heated so rapidly when the boiler water is at 180°. Also, when the boiler is operating at 180° the circulation within the boiler is much decreased and results in a further reduction of heat transfer. In all cases where such a system is installed, it is advisable to specify a submerged heater of twice the capacity required for use with boiler water at 212°. Therefore, a submerged heater designed to supply 16 families during the winter would be selected to supply eight families during the summer when the boiler water is about 180°.

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QUESTION 61. I am contemplating heating my new home entirely by electricity. The cost of power in my locality is 6 cents per kw-hr., and I am advised that the cost will be prohibitive. At this rate what would be the cost of the power required to supply heat equal to a ton of anthracite? *J. B. M.*

ANSWER. One ton of average anthracite coal releases upon burning approximately 14,000 B.t.u., and the calorific value of one ton of this coal is therefore 14,000 × 2000 = 28,000,000 B.t.u. One kilowatt-hour is equivalent to approximately 3412 B.t.u. If both coal and electricity are applied with equal efficiency, 28,000,000 ÷ 3412 = 8215 kw-hr. would be equivalent to one ton of coal. At 6 cents per kw-hr. this amount of power would cost $493.

When the relative efficiencies of coal and electricity as sources of heat are considered, however, the case for electricity is somewhat improved. When a kilowatt-hour of power is consumed by an electric heater of any kind, it liberates just exactly 3412 B.t.u. of heat, and if the heater is well designed, nearly all of this heat will be effectively applied to warming the room. The average efficiency of a coal-fired steam or hot water heating system over a season may be conservatively assumed as 45%. This is due to failure to completely burn the fuel, thereby throwing some of the heat of the coal away in the ash, to loss of combustible volatile up the chimney, to heat loss up the chimney, and to heat wasted due to the necessity of maintaining a stand by fire at times when no heat is required. Also in electricity's favor is the elimination of ash handling, coal handling, and firing. It is obvious, however, that at the 6 cents per kw-hr. rate, electric heating cannot compete economically with the burning of coal.

EDITORIALS

Oil Burner Servicing

WHEN a prominent oil company announced last June that it would offer free service to all Washington oil burner owners who purchased its oil, the action precipitated violent opposition from the organized oil equipment dealers. Our latest advice is that the company has refused to negotiate a settlement and indicates that it proposes to maintain its announced position, while the dealers, backed by their national trade association, are fighting back.

This situation has some interesting aspects not only because of its own isolated importance but even more so because of its significance in the larger scale of things. For one thing, it illustrates that the Washington equipment men realize the importance of service and know the strategic advantage which accrues to the man who controls it. In the second place, this is the first time of importance that the oil interests have moved into the equipment service field—one which has heretofore been left to the equipment men.

In being left without interference on the part of the fuel interests, the oil equipment men have been uniquely fortunate, for their fellows whose activities have to do with apparatus fired by the other fuels have had to face this same problem. It was scarcely to be expected that the oil companies would keep their hands off indefinitely, for they must have long realized that the equipment service man is in a good position to exert influence on the owner and to promote the use of oil as a fuel.

Almost exactly the same thing has taken place in the servicing of coal-fired equipment. For years, when coal was the undisputed king of the heating fuels, the coal interests maintained a total hands-off policy toward the equipment. Not only that, but they were supremely contemptuous of such matters, doubtless following the reasoning that service was no concern of theirs since the worse the condition of the apparatus the more coal would be used. Of late, however, we are beginning to see moves made which are putting the coal man into the equipment service business. Here and there coal producers are advocating plans which include equipment service to the owner. Every one of these moves means that the equipment man is being asked to surrender a part of the business which he has long enjoyed. In the case of coal, the equipment men have taken no organized steps to combat this new movement and it has not yet made general headway. Moreover, the coal service plans usually call for cooperation with local equipment men. The service work contemplates finding equipment faults through inspection and having the actual work of repair done under the direction of equipment men.

The use of gas as a heating fuel was accompanied by practices totally different from those which obtained in the case of oil. Instead of the gas producers maintaining a hands-off policy regarding installation and service, they went the whole way and took over these functions rather completely. The local equipment men took but a minor part in the rise of gas, and the gas companies not only promoted its use but in many cases took over sales, service, and even installation. Within the past year equipment men have moved to change this situation with the result that cooperative policies have been adopted.

Here, then, is a confused situation with gas servicing largely out of the hands of equipment men, with the coal interests showing signs of increasing their servicing plans, and with the oil interests just making their first moves.

Plans for keeping the servicing of equipment in the hands of equipment men and for resisting encroachments by the fuel interests are logical, and we are in sympathy with them. We believe that under present circumstances the equipment man is still best qualified in general to do this work and that it is therefore rightfully his. We believe, also, that he is going to have to demonstrate his fitness continually and increasingly, and that he may as well make up his mind that if he is to keep others from taking this work he must continue to be the one best qualified to do it. This means keeping abreast of changes, it means honest workmanship, and it means effort. If any equipment man is not prepared to do these things he may as well quit now, for he will certainly lose out finally to the organized and systematic service departments which the fuel interests can develop if they set out to do so.

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Fabricated Houses

DESIGNS for detached houses which will permit a great amount of the labor to be done at the factory have received increasing attention during the past year or two. Many have been designed and have not passed the paper or discussion stage. Of those which have reached the construction stages, three are now either completed or well along toward completion in the Cleveland vicinity. Houses of this kind have been so much discussed and so much has been predicted regarding their final wide use, that we believe the principal features of their heating plants are of interest. We are pleased to be able to include such a statement in this issue. In these houses the heating plants seem to have received close attention, and it is to be hoped that as designs continue to appear, the heating plants may not be slighted. It would be rather out of keeping to take advantage of modern production methods in the preparation of the structural material and not include modern and adequate heating.

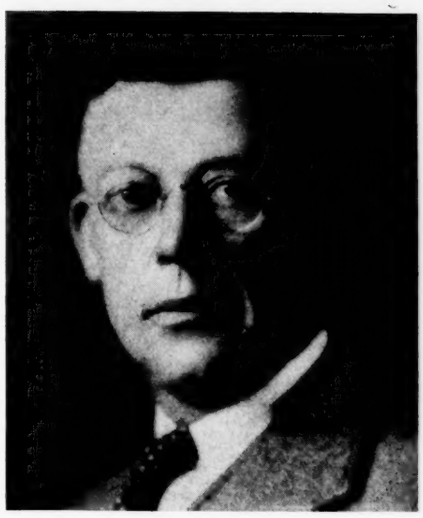
News of the Month

First Regional Chapter of N. D. H. A. Chartered at Boston

A charter for the first regional chapter of the National District Heating Association was presented to Davis S. Boyden, chairman of the chapter and head of the Boston Edison Company steam heating service department, at the initial organization meeting, held at the Engineers Club, Boston, Mass., September 28. Seventy-two members registered for the afternoon session and the dinner meeting in the evening. Semi-annual meetings are planned.

Officers elected with Mr. Boyden are: G. K. Saurwein, vice-chairman; R. M. Nee, secretary; A. J. Glossa, treasurer, and an executive committee including H. W. Coombs, E. D. Learned, and C. F. Mosher. The charter was presented by M. D. Engle, of the national executive committee of the association.

At the afternoon session, Mr. Saurwein rendered a report for the commercial relations and research committee. F. C. Meyer spoke on the subject of corrosion; and C. L. Renker told of the work of the meters and accessories committee at the same session. Irving E. Moultrop, chief engineer of the Boston



Davis S. Boyden

Edison Company, and David Chapman, head of the Smoke Abatement Division, Massachusetts Department of Public Utilities, were guest speakers of the evening.

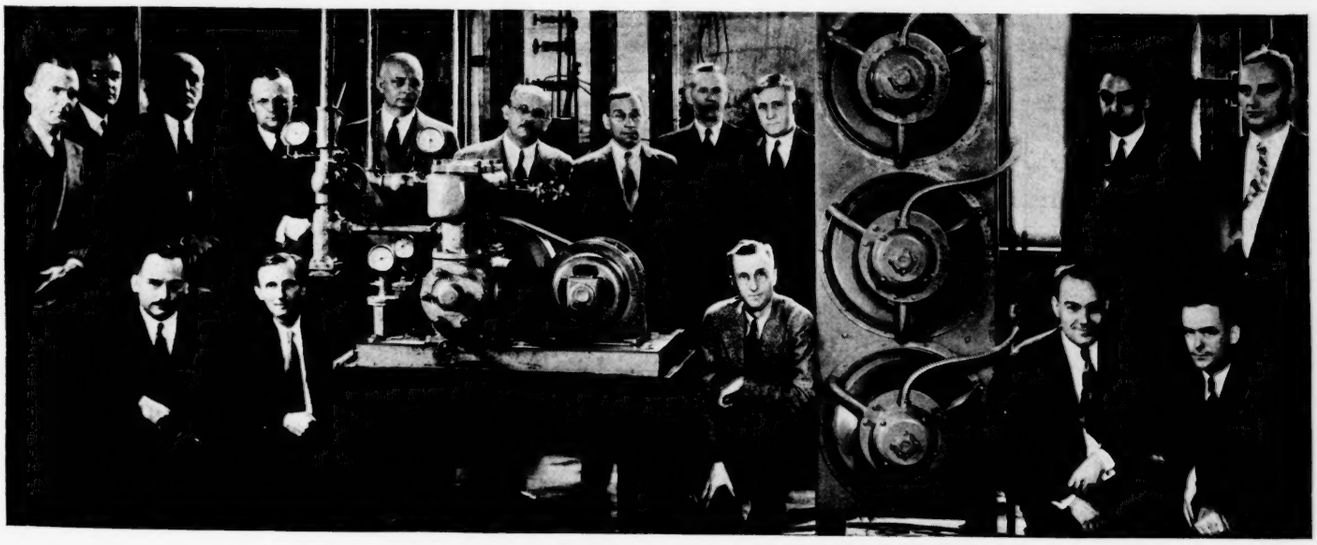
Air Conditioning Needs Laid Before A. G. A. Convention

A feature of the program of the commercial section of the American Gas Association at the annual convention held October 10-12, at Atlantic City, N. J., was a paper "Air Conditioning—Home and Industry," presented by W. R. Zuhlke, American Radiator Co., New York. The need for proper air conditions in many major industries was pointed out, and the potential domestic market was discussed. Mr. Zuhlke predicted the introduction of new methods of air conditioning which will avoid the wasteful use of water.

In concluding his remarks, the speaker said that those sufficiently foresighted to associate themselves at this time with new developments which contribute to human needs will be outstanding in the period of prosperity to follow. Many of the new developments will center around our homes, according to Mr. Zuhlke, who notes the possibility of mass production methods bringing individually-owned homes within the reach of the majority, and expressed a belief that air conditioning will contribute its share.

G. E. Man New Director of A. O. B. A.

J. J. Donovan, manager of the air conditioning department of General Electric Co., New York, was elected a director of the American Oil Burner Association at the quarterly meeting of the board of directors held during October.



York Regional Managers at Annual Meeting, September 20 22.

Top Row (Left to right)—W. S. Stair, advertising manager; J. L. Rosenmiller, sales promotion manager; W. E. Becker, southern regional manager; S. E. Lauer, general sales manager; John Laichinger, Pacific regional manager; John Schurman, central regional manager; F. A. Weisenbach, eastern regional manager; C. A. Pearson, commercial division; G. A. Westerlin, Chicago branch manager; I. C. Baker, air conditioning division manager; W. L. Hutton, western regional manager. Bottom Row (Left to right)—J. G. Bergdoll, development department; J. S. Beamensderfer, director of research; A. W. Ruff, development department; F. E. Dennison, chief of small machine design; J. C. Tweedell, commercial division manager.

News of the Month

Intensive Course in Arc Welding To Be Repeated

Success of the combined practical and theoretical one-week welding course offered by John Huntington Polytechnic Institute, Cleveland, in cooperation with The Lincoln Electric Company, has resulted in a decision to repeat the course several times during the winter season. The course consists of a week's intensive training, six days being spent in the operator's training school of The Lincoln Electric Company, and a lecture each evening from Monday to Friday on designing for arc-welded construction at the Institute. Enrollment is limited to 30 men and is restricted to graduates of engineering schools, or those having equivalent practical experience.

Further information may be had from Dean Alfred Mewett, John Huntington Polytechnic Institute, Cleveland, or from E. W. P. Smith, consulting engineer, Box 683, Cleveland.

Sarco Appoints Boston Representative

D. M. Archer, connected with the sales engineering staff of Sarco Co., New York, for three years, has been appointed representative of that company in the New England states, with offices at 11 Wolf St., West Roxbury, Boston.

Davis Engineering Appoints Blackiston

Davis Engineering Corp., New York, manufacturers of domestic and commercial hot water heaters, announces the appointment of G. P. Blackiston as its sales promotion manager.

Fleming Succeeds Ernest Szekely Co.

The business of the Ernest Szekely Co., Cleveland, Ohio, for 12 years engaged in consulting engineering, covering heating, ventilating, air conditioning, steam plants, plumbing, and electrical work, has been transferred to P. B. Fleming, connected with the organization since its inception, and in active charge for the past seven years.

Mr. Fleming will carry on the business under his own name at 308 Rockefeller Building, Cleveland.

Research Papers to Feature N. W. A. H. A. Convention

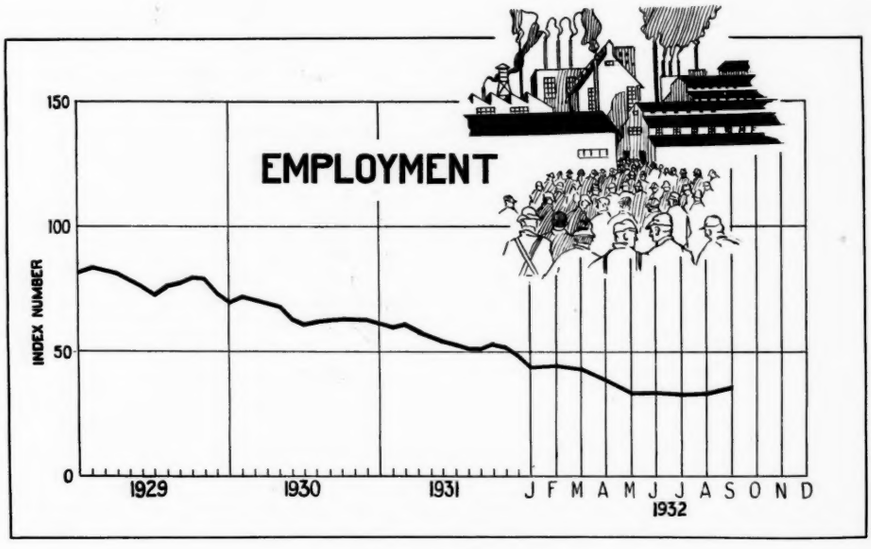
A report of the research advisory committee, by F. G. Sedgwick, chairman and an inspection of the research residence, are the scheduled events of the Wednesday morning session of the December convention of the National Warm Air Heating Association, to be held in Urbana, Ill., December 7-8. In connection with this program, A. C. Willard, professor of heating and ventilation at the University of Illinois, will present a resume of the research work during the summer and fall.

At the Wednesday afternoon session, J. D. Hoffman, chairman of the code committee, and director of the department of practical mechanics, Purdue University, will discuss the mechanical code for warm-air furnace heating systems in residences and render the report of the code committee. Dean M. S. Ketchum, of the College of Engineering, University of Illinois, will discuss the research work of the engineering experiment station of the university, and A. P. Kratz, research professor, and S. Konzo, research associate, will present recent research developments. G. D. Kingsland, Minneapolis, will speak on automatic control as applied to warm-air heating and air conditioning systems at the same session. The banquet dinner will be held at the Urbana-Lincoln Hotel at 7 p.m. on Wednesday.

The Thursday morning session will be opened with a report by D. C. Simpson on the results of tests made by Prof. Frank B. Rowley on gravity warm-air systems to determine comparative operating characteristics with and without air filters. This will be followed by an open forum in which the sales methods, installations, profits, collections, and the situation and outlook will be discussed. The convention will close with the reports of the officers and committees, and the election of new officers.

Hagen on A. S. M. E. Annual Meeting Program

A number of discussions of outstanding importance are planned for the program of the annual meeting of the American Society of Mechanical Engineers, to be held in New York, December 5-9. Among these is a paper "Pulsation in Air Flow from Fans and Its Effect on Test Procedure," by H. F. Hagen, vice-president in charge of research, B. F. Sturtevant Company.



Employment Increases

Employment in the steamfittings manufacturing industries throughout the country showed an increase during September, as indicated by the chart of the employment index numbers compiled by the Department of Labor. With the 1926 average as 100, the index shows that employment in the steamfittings plants is at 35.5% of the 1926 figure, while in August the index was only 33.1.

Offers Training Course for Air Conditioning Salesmen

Walter J. Ottinger, 1929 East 55 St., Cleveland, announces the publication of a short text for air conditioning salesmen under the title "Just What Is This Air Conditioning?" Three standard size mimeographed sheets of text and three charts comprise the set, which is offered for 75 cents in quantities from one to five, with reduced cost for large orders. Inquiries should be addressed to Mr. Ottinger.

Sturtevant Takes Over Cooling and Air Conditioning

The Cooling and Air Conditioning Corporation founded by, and until recently partly owned by, the B. F. Sturtevant Company, is now a completely-owned Sturtevant subsidiary, to be incorporated under the laws of Massachusetts. The name of the corporation will be changed to Sturtevant-Cooling and Air Conditioning Company, with headquarters at Hyde Park, Boston, Mass. Its principal officers are E. B. Freeman, president; B. S. Foss, treasurer, and H. R. Sewell, vice-president and general manager. Mr. Sewell has been with the Sturtevant Company for 17 years, for the past seven as manager of the air conditioning division.

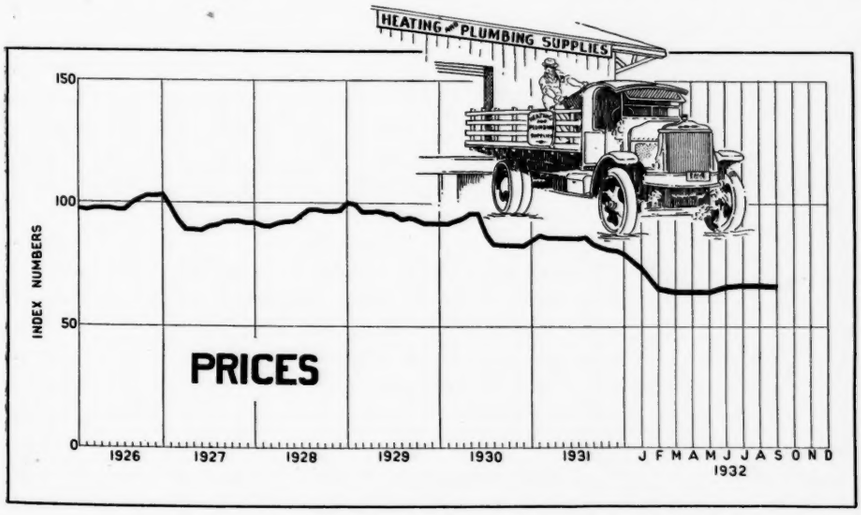
Sturtevant-Cooling and Air Conditioning Company will continue to handle public building conditioning, comfort and process work. The B. F. Sturtevant Company will handle, through the regular trade channels, the manufacturing and sale of the unit type of air conditioning product, such as coolers, humidifiers, or combinations of both.

Stokers Subject of Chicago Meeting

An address, "The New Science of Coal Use," was presented by B. R. Gebhart, public relations director of the Illinois Coal Bureau, to the Illinois Chapter of the A.S.H.V.E. at its annual meeting, held at Chicago, October 10. Mr. Gebhart discussed the various ways by which coal might be made to compete successfully with automatic oil or gas heat. He advocates the establishment of a heating department by coal dealers which would assume the responsibility for keeping the stoker and furnace equipment in good working order, and of tending the heating plant.

Carlyle M. Terry, of the Anthracite Institute, followed with a discussion on consumer service, and John Jenkins, of the Interlake Iron Corporation, spoke on the utilization of coke. A brief discussion of the handbooks and data released by the Committee of Ten, Coal and Heating Industries, was presented by Oliver Grimes.

Officers elected for the new term are: President, J. H. O'Brien; vice-president, C. W. DeLand; treasurer, J. H. Milliken; secretary, J. J. Hayes. J. J. Aeberly, retiring president, R. E. Hattis, and George B. Blanding are the new directors.



Trend of Wholesale Prices

The index of wholesale prices for heating and plumbing materials, as compiled by the Department of Labor and shown above, dropped slightly in September as compared with August, the decline being from 67.1 to 66.8 (1926 average = 100). The index for all building materials increased from 69.6 to 70.5, while the combined index of all commodities rose one point from 65.2 to 65.3.

Yale to Study Relation of Ventilation to Health

Research to determine the effect of ventilation, cooling, and heating upon human health and comfort will be carried on by Yale University in the new hygiene laboratory to be erected at New Haven as a gift from the John B. Pierce Foundation. The investigations will be made by Dr. Leonard Greenburg and Dr. L. P. Herrington, under the general supervision of Dr. C.-E. A. Winslow.

Doctor Winslow, who is an authority on public health, has long been engaged in a study of human reactions to atmospheric conditions. He was a member of the New York Commission on Ventilation. Doctor Greenburg has been a member of the United States Public Health Service for a number of years, and in this capacity has been working in the Yale laboratories on ventilation problems. Doctor Herrington is a psychologist, with special training in physiology. He is a member of the Department of Public Health at Yale.

A.O.B.A. Opposes Free Burner Service Policy

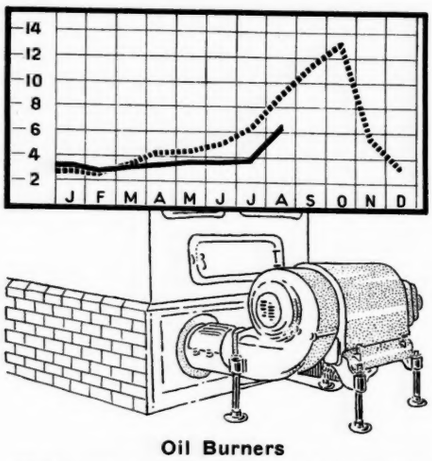
Action has been taken by the directors of the American Oil Burner Association to combat the policy adopted by Standard Oil Company of New Jersey whereby free service is extended oil burner owners in exchange for long term fuel contracts in the Washington, D. C., territory. The campaign opened on October 5, when a series of newspaper advertisements was instituted in which the public was warned against deception by the proposals of certain oil companies attempting to increase their sales in Washington, Baltimore, and Virginia. The Oil Burning Council of Merchants and Manufacturers Association of Washington is leading the fight locally, supported by oil burner manu-

facturers and independent fuel distributors.

Arthur W. Clark, managing secretary of the dealer division of the A.O.B.A., states that the association is much concerned over the effect this free service offer may have toward misleading the public, and calls attention to the idea that payment is generally made in some way sooner or later for any worthwhile service. The association also disapproves the plan of any one service organization attempting to render satisfactory service on all makes of burners. Oil burner dealers actually sell automatic heat and are, therefore, concerned in all dealings of the user having direct bearing on satisfactory automatic heat.

Ernest Williams Addresses New York Engineers

About 115 members and guests of the New York chapter, American Society of Heating and Ventilating Engineers, heard Ernest Williams, of the office of Clyde R. Place, consulting engineers, describe the mechanical equipment of Rockefeller Center at the first meeting of the season, held October 17. Mr. Williams included among the topics of his illustrated lecture the design and layout of the elevator systems, steam supply, power supply, studio soundproofing, air conditioning, and staging facilities in the theaters.

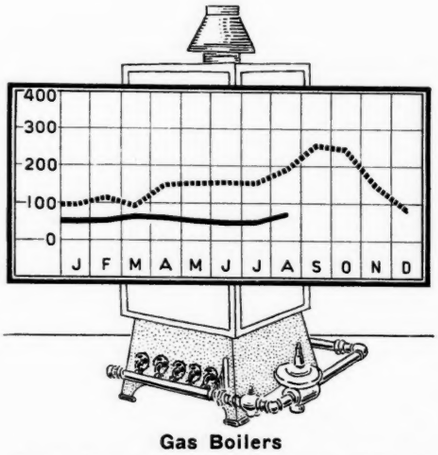


Oil Burners

Shipments of domestic and commercial oil burners in the U. S. increased during August to 6341 from 4175 in July, a rise of 52%. The August figure is, however, 29.8% below the corresponding month in 1931. Figures from U. S. Department of Commerce.

Spokane Dealers Hold Exhibit of Air Conditioning Equipment

Plumbing and heating firms of Spokane, Wash., held their first air conditioning show August 29 to September 3, for the purpose of inaugurating a campaign to educate the public in the uses and advantages of this equipment. Approximately 20 concerns participated in the exhibit, and all have reported satisfactory results. The show was publicized mainly by invitation cards distributed among interested prospects by the dealers. By agreement, no sales were closed on the floor, but the dealers were provided with good prospect lists as a result of the show.

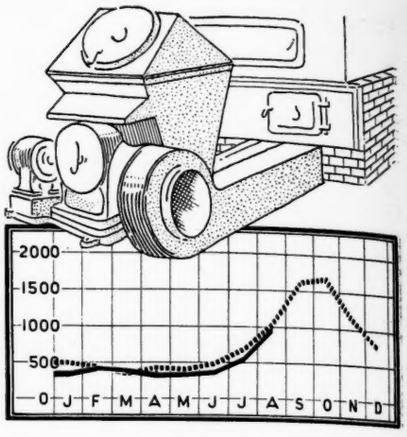


Gas Boilers

According to the Department of Commerce, shipments of gas boilers, in thousands of B.t.u. capacity, rose from 49,406 in July to 76,265 for August, a gain of 54.5%. The August, 1932, figure is off 61% from the same month last year.

Qualification of Welders Studied at Fall Meeting of A. W. S.

Among the papers presented at the fall meeting of the American Welding Society, held in Buffalo, N. Y., October 5, was "Pre-Qualification Tests for Welders," by Ernest Lunn, consulting engineer, Chicago. In it, the author outlined the most logical steps to be followed by a beginner in acquiring proficiency in the art of welding, and points out the need for a method by which an employer may classify the qualifications of welders for various kinds of work. He also proposes a standard code of specifications for tests whereby the welders' qualifications may be determined.



Stokers

A total of 977 heating stokers was installed during the month of August, an increase of 87% over July. The August figure shows a drop of only 6.8% from August, 1931.

Illinois Ice Association Hears Talk on Research Residence

At its annual fall meeting, held in Urbana, Ill., September 25, the Illinois Association of Ice Industries heard Prof. A. C. Willard, head of the Department of Mechanical Engineering, University of Illinois, describe the investigations being carried on in the university's research residence on the adaptation of air conditioning to a standard warm-air heating system. Professor Willard reported that the warm-air system had proven satisfactory for comfort cooling, in spite of previous doubts.

Cooling was done with ice, and the speaker outlined the manner in which the cooling coil was installed in a by-pass in the main duct of the air distribution system. The rooms were maintained at conditions comfortable and satisfactory to the occupants, and no objectionable condensation on the ducts or pools of cold air at the outlets had been encountered. Professor Willard stressed the effectiveness of awnings in helping to maintain cool conditions and conserving ice.

Prof. A. P. Kratz, who has been in active charge of the research work, further described the investigations and pointed out that while the cooling season had been short, outside temperatures as high as 103° had been encountered, providing a wide range of conditions for the experimental work. At the adjournment of the meeting the members of the association were conducted through the research residence.

R. C. Cosgrove

Cosgrove Heads Westinghouse Air Conditioning

R. C. Cosgrove, manager, refrigeration division, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., has been placed in charge of the company's domestic air conditioning activities, in addition to his present duties.

House-Heating by Manufactured Gas Up

Revised statistics recently issued by the American Gas Association, covering the manufactured gas industry only, contain some items of interest regarding the extent of house-heating by gas during the years 1929, 1930 and 1931. During this period the number of house-heating customers rose from nearly 44,000 to 58,670; the gas sold for heating rose from 14,261,000 thousand cubic feet to 19,908,100 thousand cubic feet; revenue increased from $12,075,500 to $16,061,500; sales per customer were nearly constant, changing only from 325 thousand cubic feet to 339 thousand cubic feet; annual revenue per customer was practically steady at $275; while the average revenue per thousand cubic feet sold fell from 85 cents to 81 cents. It is also notable that the 81-cent figure is less than the unit price for other gas uses. In other words, not only did the use of manufactured gas for house-heating increase, but this business was obtained by offering a relatively attractive price to house-heating users.

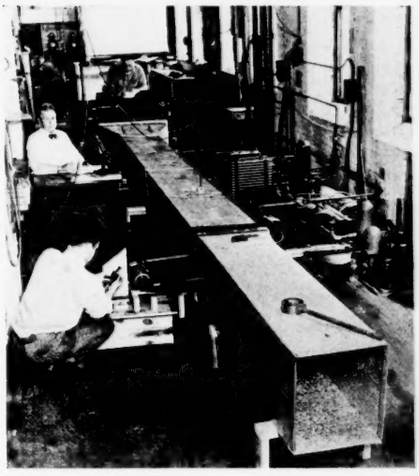
Frank O'Day

Frank O'Day, president of the Oil City Boiler Works, died October 11, at the age of 50, following an illness of six weeks. His death was attributed to a complication of diseases.

Born in Buffalo, Mr. O'Day was a son of Daniel O'Day, who was one of the original vice-presidents of the Standard Oil Company, general manager of the National Transit Company, and a co-founder with Michael Geary and B. W. Vanderdrift of the tank and boiler shop which later grew into the Oil City Boiler Works.

Frank O'Day was also president of the Venango Oil and Land Company, a director in the Oil City Trust Company, and a prominent figure in the O'Day Oil Company, with large holdings in Pennsylvania, Ohio, and West Virginia.

He is survived by his wife and three sons.



Testing efficiency of Owens-Illinois Dustop filter for giving hay fever relief, in the laboratory of the E. Vernon Hill Co., Chicago.

COMING EVENTS

NOVEMBER 30-DECEMBER 4, 1932. Annual Meeting of the American Society of Mechanical Engineers, to be held in the Engineering Societies Building, New York.

DECEMBER 5-10, 1932. Tenth National Exposition of Power and Mechanical Engineering, to be held at the Grand Central Palace, New York.

DECEMBER 7-8, 1932. Meeting of the National Warm Air Heating Association, to be held in Urbana, Ill. Headquarters at the Urbana-Lincoln Hotel.

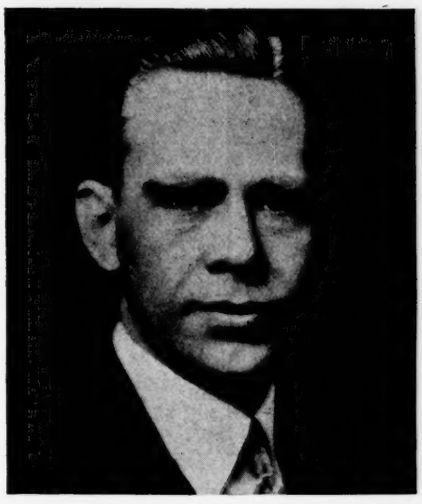
DECEMBER 7-10, 1932. Twenty-Eighth Annual Meeting of the American Society of Refrigerating Engineers, to be held in New York.

JANUARY 23-25, 1933. Thirty-Ninth Annual Meeting of the American Society of Heating and Ventilating Engineers, to be held in Cincinnati, Ohio.

JUNE 12-17, 1933. Tenth Annual Convention of the American Oil Burner Association, to be held in Chicago. Headquarters at the Hotel Stevens.

September Home Building Up 6.3%

September showed an increase of 6.3% in the number, and an increase of 9.9% in the estimated cost, of new residential buildings as compared with August, according to reports of building permits received by the Bureau of Labor Statistics of the United States Department of Labor from 353 identical cities. The estimated cost of all building operations for which permits were issued in these cities during September was $31,768,068. This was a decrease of 15.2% as compared with August.



C. A. Pearson

Pearson New Supervisor of Commercial Sales for York

C. A. Pearson has recently been appointed national supervisor of commercial sales for the York Ice Machinery Corp., York, Pa. Plans for introducing a new line of small tonnage commercial refrigerating machines using the recently developed refrigerant freon are to be announced shortly by this company.

Correspondence

Ventilating Dead Spaces in Basements

EDITOR, HEATING AND VENTILATING:

Referring to the article in the September issue of HEATING AND VENTILATING, entitled "Ventilating Dead Space in a Basement," the writer had experienced some difficulty in the operation of this type of supply duct on a recent job.

The purpose of the suction connection was intended for the recirculation of air in the dead space under the main horizontal duct.

However, when the fans were put in operation, it was observed that the air discharging through the supply connection increased the frictional resistance behind the louvered register, causing an eddy current of air which retarded the air at the suction side of the duct and forming no circulation.

This trouble was eliminated by replacing the louvered registers on the supply and suction connection with wire screens 1½ in. mesh.

STEPHEN W. MOLOKIE

Staten Island, N. Y.

Air Conditioning and the Heating Contractor

EDITOR, HEATING AND VENTILATING:

A careful perusal of the October, 1932, issue of HEATING AND VENTILATING affords one excuse for these comments.

We agree heartily that the term "Air Conditioning" is a misnomer so far as the majority of apparatus offered is concerned.

The compilers of the tentative code, presented through the joint code committee of the National Warm Air Heating Association and the Furnace Blowers Manufacturing Association, carefully avoid this term, and speak of theirs as a code for mechanical warm-air furnace heating, although many of the firms interested do provide for cleaning and humidifying, as well as heating and circulating the air. In many cases, too, they specify that the same apparatus can be used for cooling.

As far as the average detached residence is affected, it seems hardly probable that many homeowners will be interested in summer cooling, and in our opinion the heating contractor who stresses this is wasting energy. Also, he is letting himself in for trouble when a hot spell does arrive.

In this latitude our heating season averages about 210 days, while excessively high temperatures, either day or night, rarely exceed two weeks. Two or three ordinary electric fans, costing only a few dollars and using scarcely more current each than an ordinary electric bulb, will usually prevent any feeling of positive discomfort.

This is a practical way of looking at a problem that should really be confined to larger buildings with large numbers of occupants. There the problem is entirely different, a point forcibly brought out in the issue referred to.

There is a phase of the controlled heat problem that the would-be successful heating contractor should not overlook. Heretofore the heating of the majority of small homes involved only two, or at the most, three trades. If warm air was used the sheet metal contractor furnished all the labor involved. If steam or hot water was to be the medium, a steamfitter or a plumber who combined the two trades did all the work.

Now, however, a third trade enters the picture, the electrician, and if the heating contractor is to be successful he must know how to plan accurately all electrical connections and be able to check their correct installation.

Not only must he see that these are properly connected, but he must be able to adjust accurately the thermostat and other controls, and to explain them all to the homeowner and his wife so that they will be able to handle them. To read the literature put out by manufacturers one would think all this was easy of accomplishment, but long experience with the users of heating apparatus leads to the opposite conclusion.

This is still further complicated by the sales propaganda of oil-burning and automatic stoker manufacturers and the 57 varieties of bituminous fuels and fuel oils.

In other words, the present day heating contractor has a complex job ahead. It covers not alone his own education, but the education of his clientele, and unfortunately he has to compete with all the rival sellers of individual accessories which may be offered to confuse his prospect's mind.

We are not objecting or opposing all this; we are simply urging the heating contractor to study all the up-to-date methods, but to soft pedal his enthusiastic endorsement until the test of time and the general education of the public make clear the open road.

We are aware that the automobile is held as a shining example of what can be done by way of education. This comparison now does not take into account the number of manufacturers and distributors who have fallen by the wayside, or the different attitude of the public.

The public expects a car to be worn out and replaced within an average period of from three to five years, but it expects its heating apparatus to last a lifetime, or at least 15 to 20 years. The buying public has been educated to the idea that the price set for an automobile is the price that has to be paid. The buyer does not go to the car merchant with a more or less complete specification and ask for competitive bids as he does with heating.

C. M. LYMAN

Utica, N. Y.

Panel Heating

EDITOR, HEATING AND VENTILATING:

In the September, 1932, issue of HEATING AND VENTILATING there is a brief article referring to research work carried out by the Building Research Department of the Department of Scientific and Industrial Research of Great Britain. This article states that the heat requirements of rooms warmed without ventilation by the panel system are approximately 14% greater than with convection heating.

I would like to draw your attention to the fact that this was the result obtained when an entirely sealed room was used. It was found

later that when a small air brick in one corner was left open, allowing a very gradual air change, the increase of consumption of the convection heaters was approximately 9%, whereas there was no appreciable increase in the consumption of the panels. There is a great economy in the use of panels under conditions of air change which occur normally in occupied buildings. In England, the figure of economy is accepted at 30%. Richard Crittall & Co., Ltd., pioneers in panel heating, have found this figure reasonably accurate, and this figure has also been given by A. H. Barker in a paper on radiant heating before the Heating and Ventilating Engineers.

RICHARD A. WOLFF
Wolff & Munier, Inc.,
New York, N. Y.

Conditioning Units—A Reference List (Supplement)

IN the October issue, pages 41-66, a reference list of available air conditioning equipment was presented. The following two items are published as a supplement to that material, the one having been omitted from the original list, and the other incorrectly presented.

Air-control Systems, Inc., Chicago, Ill.

Trade Name: Zephyr Air.

Type: Direct unit.

Includes: Washer unit with low pressure atomizer, fan, finned core for heating or cooling, cabinet enclosure when replacing radiator, ducts when installed in basement, ice storage system in which ice is alternately frozen and melted when cooling wanted only 8 hr. to 12 hr. per day.

Fuel: Any—replaces radiator for heating.

Sizes and Capacities: "Zephyr 75"—humidification and air washing, up to 40,000 cu. ft.; room heating, equivalent to 30 sq. ft. to 40 sq. ft.; cooling, one ton (12,000 B.t.u. per hr.), using one ton compressor for 24 hr. cooling or ½ ton with ice storage system.

Remarks: Requires connections to electric, water supply and waste, also heating and cooling pipe connections.

The Peerless Electric Co., Warren, Ohio.

Trade Name: Peerless.

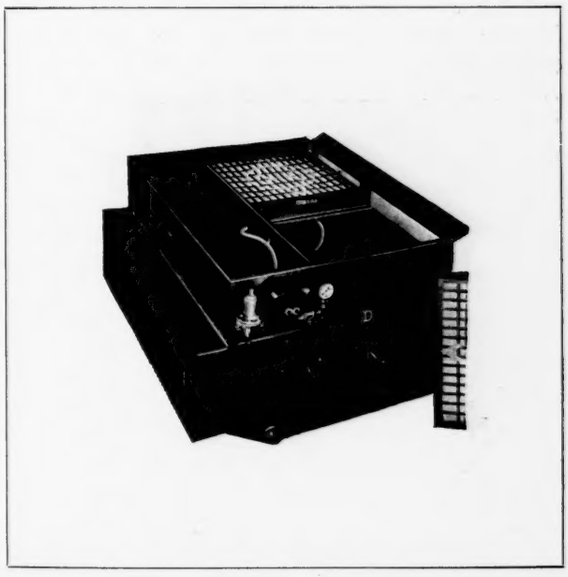
Type: Fabricated unit for use with *warm-air* plant.

Includes: Direct-driven blower with capacitor motor, washer, and filters.

Fuel: None; unit does not include a furnace.

Sizes and Capacities: Three standard sizes. Also special sizes.

Remarks: Has double blower driven by single motor. Feature of unit is three-speed controller which is connected to a furnace temperature controller. Company advocates continuous operation of blowers; reports finding electrical consumption is little higher than with intermittent operation, but the rise in charges is balanced by lower fuel consumption and improved air conditions in building. Maker also offers blower wheels and motors for application by furnace manufacturers to their units.



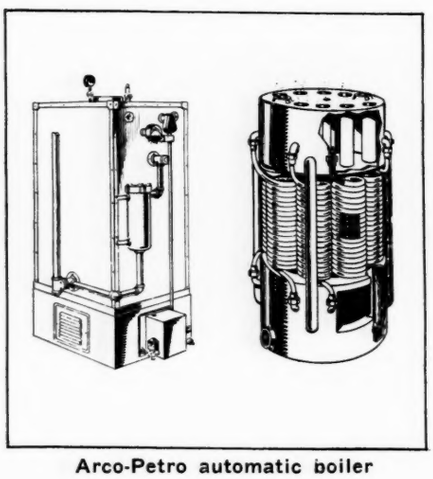
New Equipment

Arco-Petro Boiler-Burner Combination

Arco-Petro automatic boiler equipment for domestic steam or hot water heating systems has recently been announced as a joint product of American Radiator Co., New York, and Petroleum Heat & Power Co., Stamford, Conn.

Units are shipped complete in three crates, the assembled boiler in one, the burner in another, and the controls and accessories in a third. Cast-iron construction is used in the smaller boilers, and copper and steel are used for boilers of 800 sq. ft. capacity and larger. Staggered flue travel, small water content, and accelerated internal circulation promote rapid heat absorption. Copper coils in the larger boilers are held in bronze compression fittings which are threaded into the steel plate water leg and dome. Provision is made for the addition of an indirect water heater which will operate winter and summer with suitable control. The boiler is encased in a steel jacket and 2 in. of asbestos insulation minimize heat loss.

Burner is an adaptation of the Petro and NoKol rotary, producing a wall-wiping type of flame. A small 1/12-hp. motor drives the head assembly, the only rotating part in the burner. This head contains a fan which in operation continually draws a column of cool air through the louvers in the side of the base. Fuel oil is thrown out through tubes by the centrifugal action of the rotary head into a column of air discharged by the fan. Air and oil travel across the hearth to the ring of refractory surrounding the combustion space, and here combine to form a highly turbulent, combustible mixture. Either gas pilot or electrical ignition may be used, and operation is fully automatic.



Arco-Petro automatic boiler

The unit is available in six sizes, ranging in capacity from 285 sq. ft. to 1200 sq. ft. of direct steam radiation, and from 456 sq. ft. to 1920 sq. ft. of hot water radiation.

A. C. & F. Develops Car Pre-Cooler

Apparatus for pre-cooling and dehumidifying the air in railroad cars previous to starting on runs is being manufactured by American Car and Foundry Co., 30 Church St., New York.

Railroad car pre-cooler

Four 300-lb. blocks of ice are charged into the machine. These are supported in an upright position on sloping grates with the lower portion of the two forward blocks submerged in water. This water is circulated by a motor-driven pump, and is played on the ice blocks by spray nozzles. The reservoir is of sufficient capacity for a two-hour run before draining becomes necessary.

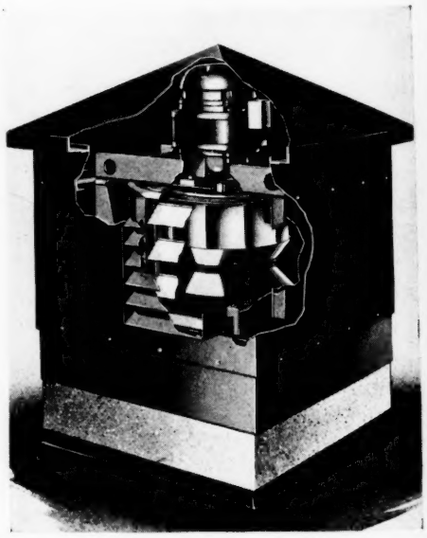
Recirculated air from the car is drawn in through a canvas suction duct by means of a motor-driven blower. This air passes into the ice chamber between the blocks where it is pre-cooled. At the end of this passage the air is divided into the two side passages and is passed over the ice and through the sprays where it is chilled and dehumidified. Entrained water is prevented from entering the air chamber by eliminator plates at the forward end of the ice chamber. The cold air is then delivered into the car through a canvas duct having its discharge end secured to a metal window slide inserted into the car window.

Machines are mounted either on casters or on rubber-tired wheels. A 1/3 hp. motor drives the pump, and the blower is powered by a ¾ hp. motor. The pump has a capacity of 15 g.p.m. against a 35 ft. head. The blower is of the dual squirrel cage type, and is capable of delivering 2000 c.f.m.

Enclosed Ventilating Fan Requires No Housing

Designed specifically for application in exposed locations, the PentVent, a fully enclosed and weatherproof centrifugal ventilating fan, was recently announced by The Bishop & Babcock Mfg. Co., 4901 Hamilton Ave., N. E., Cleveland. No separate penthouse or further protection from the weather is necessary, and the manufacturer recommends the unit as ideally adapted to roof mounting where it can be arranged to cap toilet exhaust stacks, central vent ducts, or other shafts.

A backward-curved centrifugal fan is mounted directly on the motor shaft in a vertical position and discharges through two outlets faced



Bishop and Babcock PentVent

in opposite directions, to compensate for wind velocity and direction. Each of these outlets is equipped with an automatic louver which prevents entrance of rain, insects, and backdrafts when the fan is shut down. A set of stationary louvers protects the automatic shutters against ice formation and other interference.

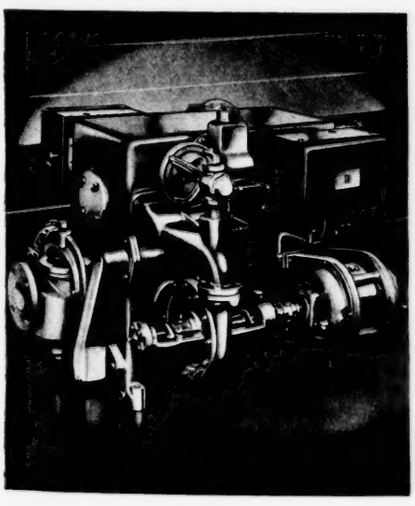
Standard housings are constructed of heavy sheet copper, and sides extended 3 in. below the coping to prevent water seepage. The top is removable to permit access to the motor. Both fan and motor are designed for quiet operation, and have a non-overloading horsepower characteristic. The unit can be operated against heads as high as ¾ in. static pressure.

Improvements Made in Economy Pumps

A number of improvements and several new features have been announced in the redesigned line of Hoffman-Economy vacuum pumps and condensation pumps, manufactured by The Economy Pump Co., Chicago, Ill.

Receivers are rectangular in shape and are of sturdy and non-corrosive cast-iron construction. Motors are of standard make, permitting quick replacement, and the pumps have been so designed as to make all parts readily accessible.

Manufacturer states that at 160° water temperature and 6 in. vacuum, the pump capacity for both air and water is 100%. At 195° and 3 in. vacuum, the pump capacity is 85% for air and 100% for water.

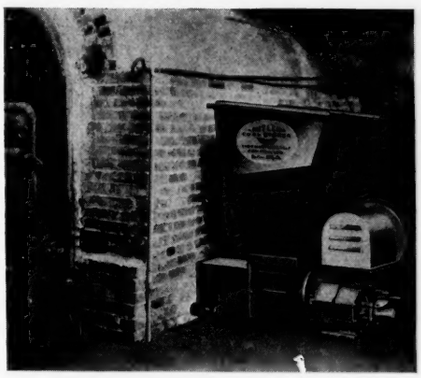


Hoffman-Economy vacuum pump

Butler Stoker has Variable-Speed Transmission

Butler Mfg. Co., Kansas City, Mo., is marketing the Butler worm type underfeed stoker in sizes suitable for a wide range of heating applications.

A gear train, consisting of one worm and gear speed reduction, and with three to four spur gear reductions depending upon the size of the unit, is driven by a motor, carrying on its shaft a sheave and fan rotor. A lever on the gear case permits operation of the worm feed at either two or three different speeds, as well as providing a neutral position in which the worm is not feeding coal but the fan continues in operation. The number of these speed adjustments is doubled by shifting the belt from one set of pulleys to the other. A shear pin is included in the mechanism to prevent damage in case of foreign material jamming in the feed screw.



Side installation of Butler stoker, showing speed transmission

Ten sizes of stoker are made. Coal-burning capacities range from 35 lb. per hr. to 1200 lb. per hr., and heating capacities range from 875 sq. ft. to 30,000 sq. ft. of direct steam radiation.

Humidistat Operates on Small Moisture Differential

Lewis Air Conditioners, Inc., 829 Second Ave., Minneapolis, Minn., has announced a new and improved model of the Humitrol, a humidistat for controlling electrically the operation of any humidity-regulating apparatus.

Hygroscopic element consists of a ribbon of moisture-sensitive material passed over rollers around the inside of the molded bakelite case. Expansion and contraction of the ribbon is transmitted through a lever mechanism to operate a mercury tube switch.

Casing is 7⅞ in. long, 2⅞ in. wide, and 1¾ in. deep. The mercury switch is of two ampere capacity for 110 volt alternating or direct current. For heavier loads, a relay of correct capacity is placed in the circuit. The manufacturer states that the device is calibrated for a maximum operating differential of within 3° above or below the setting.

Improvements Announced in Williams Oil-O-Matics

Williams Oil-O-Matic Heating Corp., Bloomington, Ill., has announced the Model KB burner, embodying refinements and improvements over the Model K burner. Among the improvements listed are reduction of operating noise, reduction of power consumption, simplification of mechanism, and greater accessibility of parts. Moving parts are mounted on a single shaft.

Humidifier Attached to Fan

Lloyd S. Read, 124 W. Fourth St., Los Angeles, Calif., is distributing a humidifying device known as the Kul-R-Air. The unit may be attached to any electric fan of the usual type, and is sold for home, office, store, and similar uses.

Water in the tank is evaporated by electrically applied heat, and is introduced into the air stream

Kul-R-Air on fan

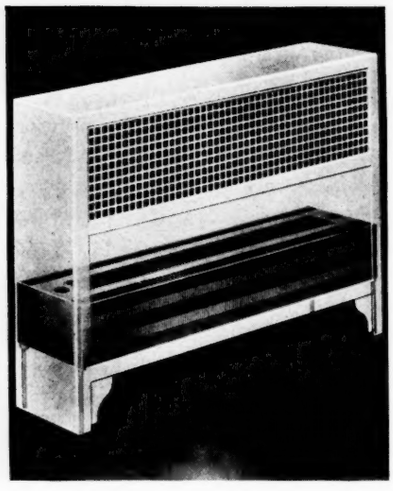
passing through the fan through two jets. Connection to the lighting circuit is made with a cord and plug. When all the water has been evaporated, the device is automatically disconnected. One filling of the tank is sufficient for 6 hr. to 8 hr. of continuous operation.

Centrifugal Pumping Unit Mounted on Standard Motor

American Steam Pump Co., Battle Creek, Mich., is marketing a line of American-Marsh Motor-Unit centrifugal pumps for air washers, humidifiers, filters, brine circulation, hot or cold water circulation, sprinkler systems, and general industrial applications. Pumps are single stage, single suction, and are available in types MUE and MUI for end suction and inside suction, respectively.

The pumping unit is designed to attach rigidly to a motor of standard manufacture, either single phase, polyphase, or direct current, operating at speeds of 1750 r.p.m. and 3500 r.p.m. Thus, in the event of motor disability, the motor may be replaced by one of similar make and characteristics from local stock. The pump impeller shaft is machined to fit the motor shaft and is secured to it by a removable pin held in place by the position of the water slinger. The impeller, shaft, and casing ring of type MUI are easily withdrawn upon removal of the outboard head, and the water slinger, stuffing box gland, and lantern gland are all split and can be quickly removed and replaced if necessary. Similar accessibility is afforded in the end suction type, excepting that the suction and discharge piping must be disconnected in order to remove the volute casing. The impeller is integral with the shaft in this type. A minimum of floor space is required since the motor and pump are close-coupled, and as each type of pump is supported by the motor feet, no foundation other than a suitable support for the weight of the outfit is required. The unit will operate in horizontal, vertical, or inclined positions.

Type MUE is made in three sizes and will discharge from 5 g.p.m. to 150 g.p.m. against heads ranging from 5 ft. to 120 ft. Type



MUI is available in four sizes, and will discharge from 50 g.p.m. to 450 g.p.m. against heads ranging from 5 ft. to 120 ft.

Stoker Introduces Coal Through Fire Door

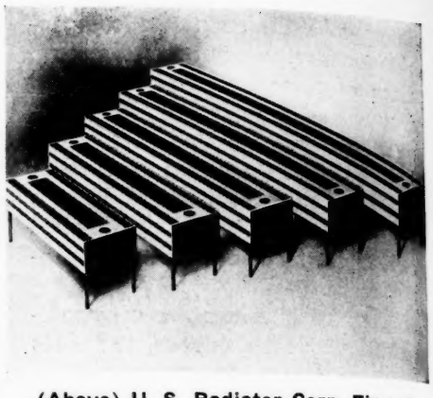
Auto-Home Stoker Corp., 1728 South Michigan Ave., Chicago, is manufacturing the Auto-Home stoker, designed primarily for the heating plants in average homes of from six to twelve rooms.

Stoker consists of an electrically-driven shovel, propelled in and out of the fire door by means of a rack and pinion mechanism to deposit fuel on the fire as needed. A lever arm, having a block of fire brick at its outer end, rests on top of the bed of coal in the combustion chamber, and as the level falls due to consumption of the fuel, it sets the stoker into operation until the fire has been built up to the required level. An arm connected to the main driving gear operates the shaker bar automatically.

Cast Iron Radiator Made in One Piece

United States Radiator Corp., Detroit, Mich., is manufacturing the Capitol Fincast concealed radiation. Heating elements are of cast iron in one piece.

Smaller sizes have a single fluid chamber, centrally located, extending the full length of the radiator, while in the larger sizes there are two fluid chambers, proportionately spaced. Fins are cast integrally with these central passages and are joined together at their vertical outer edges to form the side walls of the radiator. Suitable enclosures and casings are supplied.



(Above) U. S. Radiator Corp. Fincast elements. (Left) Phantom view of Capitol casing

Elements are made in widths of 3½ in., 5⅜ in., 7¼ in., and 10⅝ in., and in lengths from 18 in. to 63 in., progressing in steps of 5 in. The height of the radiator elements is 4½ in. They range in capacity from 8.5 sq. ft. to 127.5 sq. ft. of equivalent direct steam radiation when installed in cabinets with front outlet grilles, and from 9.85 sq. ft. and up, in cabinets having top openings. Concealed ratings vary with height of stack.

Paramount Conversion Burner

Bialosky Bros. & Co., 6611 Euclid Ave., Cleveland, are marketing the Paramount conversion gas burner for domestic heating systems.

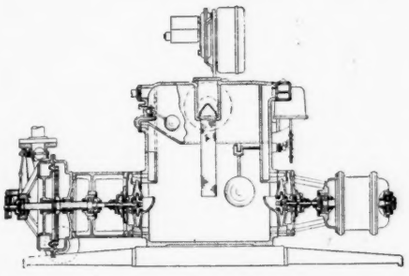
Burner is of the blower type and is installed through the ash-pit door. The burner head, which may be either circular or rectangular to correspond to the shape of the fire pot of the heater, rests on the grate bars. It is of heavy cast iron, with a series of vertical slots around its periphery, and is set so that the flame is projected horizontally and radially directly at the inner surface of the combustion chamber. Cast-iron baffles guide the flame and hot gases upward in close contact with the surface of the combustion chamber, and at the top of this travel, the products of combustion are imparted a final swirling motion by spiral spacer blades. The fan is set in a horizontal position and is driven by a vertical motor.

A room thermostat wired in series with an electric safety pilot regulates the operation of the burner to the heating requirements of the building. The gas supply valve is regulated by a fly-ball governor on

the lower end of the motor shaft. After the gas valve is closed, the motor continues in operation for a brief period to blow out residue and unburned gases. A draft hood is supplied with the burner which regulates the stack draft for either coal firing or gas firing. An ash-pit door to accommodate the burner is also included. The burner consumes from 30 to 150 cu. ft. of gas per hour.

Vacuum Pump is Turbine-Driven

Nash Engineering Co., South Norwalk, Conn., has announced the Jennings vapor turbine heating



Sectional view, vapor turbine pump

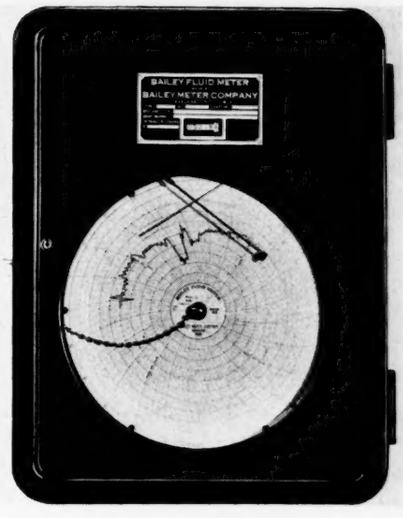
pump, a vacuum pump driven by steam from the supply main, eliminating the cost of electric power.

Pump operates on a pressure differential of 2½ lb. per sq. in. between the supply and the inlet, regardless of whether the system is operated above or below atmospheric pressure. This differential is constantly and correctly maintained by the vapor turbine valve which is so proportioned that the proper quantity of steam is passed from the supply main to the turbine under all load conditions. After passing through the turbine, the steam is returned to the heating system, having given up heat represented by 2½ lb. expansion, equivalent to approximately ¾ of 1% of the total heat of the steam.

Condensate and air are handled in separate pump elements, consisting of a centrifugal pump combined with the Hytor vacuum pump, delivering maximum condensate capacity at the same time it delivers maximum air capacity. A complete electrically-operated stand-by unit with full automatic control by vacuum and float is combined with the turbine-driven pump as a safety measure. The capacity of both pumps can be utilized under peak load conditions, and the electrically-driven unit will be cut in automatically at any time that the steam supply is not adequate to operate the turbine. An emergency trip cuts off the steam supply in the event that conditions are such that the turbine is subject to overspeed. Pumps are manufactured in 10 sizes.

New Line of Fluid Meters Announced

Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, has announced a new line of fluid meters for the measurement of flow of steam, water, gases, and other fluids. They are available in three general combinations: indicating and integrating, recording and integrating, and indicating, recording, and integrating. The record is made in pounds per hour, gallons per minute, or any other desired units, on a 24-hr. chart, 12 in. in diameter. Flow graduations are uniformly spaced



Bailey fluid meter

throughout the entire range, facilitating comparison with records of pressure and temperature which may be obtained on the same chart by incorporating auxiliary recorders in the flow meter casing.

Differential of pressures between inlet and outlet sides of an orifice or other primary element inserted in the pipe line operates the mechanism. The inlet side is connected to the interior of a mercury-sealed Ledoux bell, and the outlet side is applied to the exterior of the bell. This bell responds to changes in the pressure differential, and moves up or down to correspond directly to the rate of flow. Guide links restrict the movement of the bell to a definite path, an advantageous feature when the instrument is for marine or portable use.

Meters are available for use with any commercial operating pressure, and the manufacturer states that permanent calibration is assured by adequate protection against sudden surges and reversals of flow. A Warren synchronous motor drives the integrator and chart.

Radiator Traps Fitted with Soldering Joints

Standard bellows radiator traps, manufactured by The Trane Co., LaCrosse, Wis., are now equipped with fittings for direct solder joints to the riser or runout to simplify the work of the heating contractor on building installations where copper piping is used. This inbuilt feature relieves the contractor of the cost of purchasing an adapter and of the labor of applying it to the trap. The fitting is manufactured under the Mueller Company Streamline Division patents.

Blower-Filter-Washer for Warm-Air Systems

Peerless Electric Co., Warren, Ohio, has announced the Peerless blower-filter-washer unit for use in warm-air heating systems.

Apparatus is completely enclosed in a metal casing. The blower chamber houses two small diameter blower wheels with forward curved blades, direct-driven by a Peerless variable speed motor of the capacitor type. Dry filters, totalling 400 sq. in. of area, remove dust from the air stream and a series of spray nozzles in the washer chamber wash and humidify the air before it is delivered to the furnace casing.

A three-speed motor controller provides for selective speed opera-

tion, and a furnace bonnet control varies the air volume and humidification capacities to meet varying conditions. This also serves as a limit control to shut down the blower when the furnace temperature falls below a predetermined level. A summer switch, included in the bonnet control, permits operation of the unit without the washer feature, so that basement air, or air from an outside duct may be filtered and circulated during warm weather.The device may be installed with a cold air return, or without it. It is manufactured in three standard sizes, with special sizes available.

Switch Regulates Pressure of Domestic Water Supply System

A pressure regulator switch with motor overload protection, for use on domestic water supply systems, has been announced by Cutler-Hammer, Inc., Milwaukee, Wis. The switch is rated for ¾ hp. on alternating current, and ½ hp. on direct current. The contact mechanism will handle safely six times the full load motor current, or open the stalled motor circuit by means of a thermal overload device. Systems may be operated at 65 lb., and a differential pressure adjustment of from 12 lb. to 28 lb. is possible.

Petro Sells Kelly Safety Control

Petroleum Heat and Power Co., Stamford, Conn., is marketing the Kelly safety boiler control, a device which breaks an electric circuit to stop the operation of an oil, gas burner, or automatic stoker in the event of the boiler water level falling to an unsafe low, or generation of excessive steam pressure.

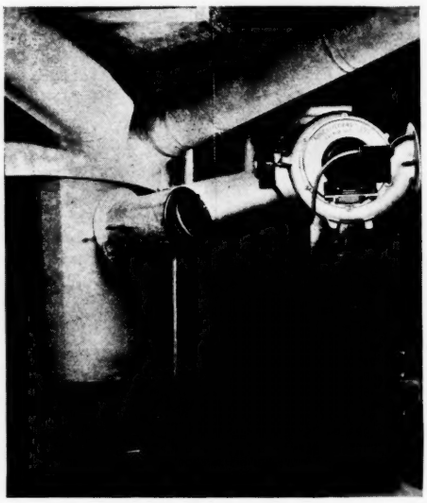
Two spring terminals exert a constant tension on a link made of fusible metal, which holds them together and completes the electrical circuit. The unit is screwed into an adapter which is installed in a hot gas pass, the flue collar, or the flue pipe at the safe low water level. Pipe connections to the boiler keep the control surrounded with boiler water as long as the normal level is maintained. If the water drops below the safe low level, the water leaves the adapter and the hot gases of combustion quickly melt the fuse.

Fuses are of an alloy that does not soften until it is exposed to a temperature very near to its melting point. A time lag of approximately 2 min. is allowed by the fuse after the melting temperature has been reached, which insures that the operation of the boiler will not be interrupted due to surging or priming. Replacement of the fuse is a simple operation.

Standard fuse melts at a temperature corresponding to steam at 9½ lb. pressure. Fuses are available for other pressure and temperature requirements, including hot water. The control can also be had for closing instead of opening the circuit.

Induced Draft for Burning Inexpensive Fuels

A motor-driven centrifugal fan for providing an induced draft in



Vacu-Draft installed

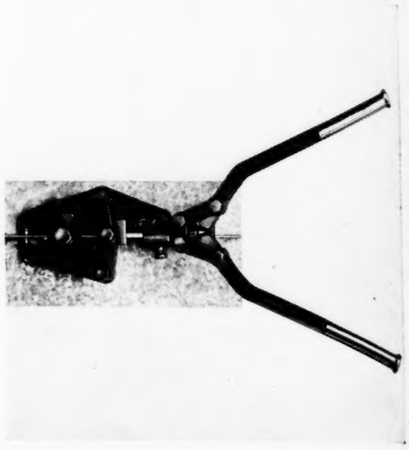
heating boilers and warm-air furnaces in residential, institutional, and commercial buildings is being marketed by Vacu-Draft Corp., Muncie, Ind. The manufacturer states that by its use bituminous as well as the smaller and less expensive sizes of anthracite can be completely burned. It also makes possible the rapid starting of a cold system.

Fan is mounted outside the brickwork of the chimney, and the smoke pipe from the boiler or furnace is connected into it. Thermostatic control starts and stops the motor to conform to the draft requirements.

Tool for Forming Button Joints in Sheet Metal

Whitney Metal Tool Co., Rockford, Ill., is manufacturing the No. 9 button punch for joining sheet metal without the use of punchings and rivets.

Handles will revolve in a complete circle independently of the jaws, making it possible to work in almost any position. A stop is provided for regulating the depth of



Whitney No. 9 button punch

the button impression. It is said to operate with ease with four thicknesses of 18 gauge metal, the pressure on the dies at the extreme end of the stroke being more than 100 times that applied to the ends of the handles. The tool is 21½ in. long, and weighs 8½ lb.

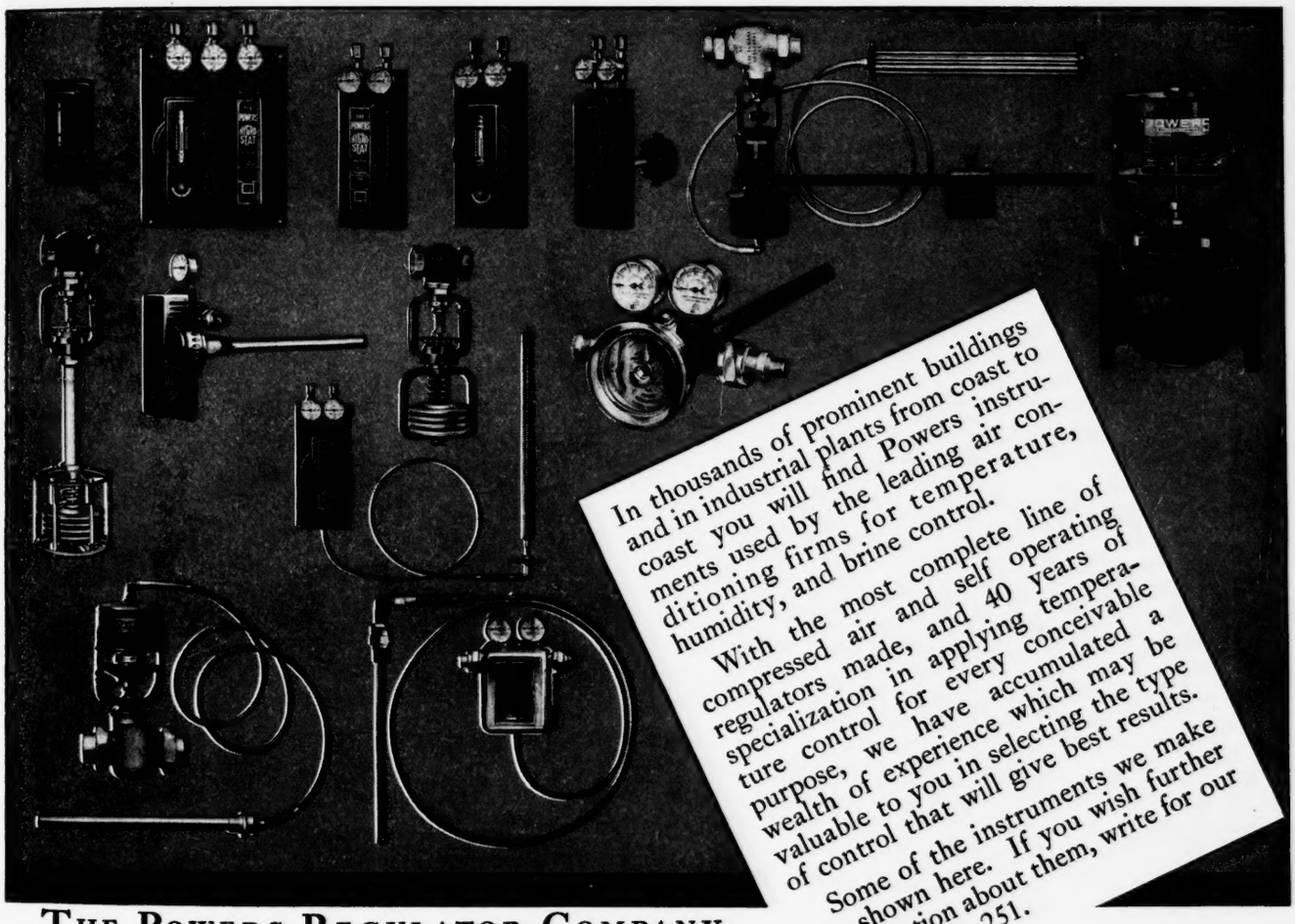
Wrought Iron Pipe Bends to Short Radius

A. M. Byers Co., Clark Building, Pittsburgh, has introduced wrought iron bending pipe which may, as a result of accurate ductility control during manufacture, be cold- or hot-bent into turns of extremely short radius without injuring its strength. The corrosion and fatigue-resisting qualities of regular wrought iron are retained in full in this pipe, according to the manufacturer, who states that it has wide application in the refrigerating industry and pipefitting work in general.

On cold bends, the extra heavy pipe can be bent to a center-to-center diameter as low as 3.3 times the outside diameter of the pipe, and hot bends can be made to much smaller center-to-center diameters. It is made in both standard and extra heavy weight in nominal sizes from ⅛ in. to 12 in.

If IT'S AIR CONDITIONING CONTROL *SEE* POWERS

INSTRUMENTS for CONTROLLING AIR CONDITIONING EQUIPMENT



In thousands of prominent buildings and in industrial plants from coast to coast you will find Powers instruments used by the leading air conditioning firms for temperature, humidity, and brine control.

With the most complete line of compressed air and self operating regulators made, and 40 years of specialization in applying temperature control for every conceivable purpose, we have accumulated a wealth of experience which may be valuable to you in selecting the type of control that will give best results.

Some of the instruments we make are shown here. If you wish further information about them, write for our Bulletin No. 251.

THE POWERS REGULATOR COMPANY

40 years of specialization in temperature control.

CHICAGO: 2718 Greenview Ave. NEW YORK: 231 E. 46th St.

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Birmingham	Chattanooga	Davenport, Ia.	Houston	Milwaukee	Pittsburgh	Salt Lake City	Montreal
Boston	Cincinnati	Denver	Indianapolis	Minneapolis	Portland, Ore.	San Francisco	Vancouver
Buffalo	Cleveland	Detroit	Kansas City	Nashville	Reading, Pa.	Seattle	Winnipeg

Degree Days and Unit Fuel Consumption in Typical Cities

September, 1932

UNIT fuel consumption figures given below must be corrected for efficiency, heat content of fuel other than that listed below, for radiation emitting other than 240 B.t.u. per hr., and for radiation calculated on a basis other than zero outside to 70° inside.

Coal is assumed as having a heat content of 12,000 B.t.u. per lb., gas, 1000 B.t.u. per cu. ft., and oil, 140,000 B.t.u. per gal. To correct for other heating values, multiply the fuel consumption listed under the charts by the standard heat content just listed, and divide by the heat content of the fuel actually being used in the installation being calculated.

For radiation installed for any other outside temperature than zero, multiply the fuel consumption given under the charts by 70°, divided by the quantity (70 minus the outside temperature used).

To correct for efficiency, divide the fuel consumption by the efficiency of the heating installation.

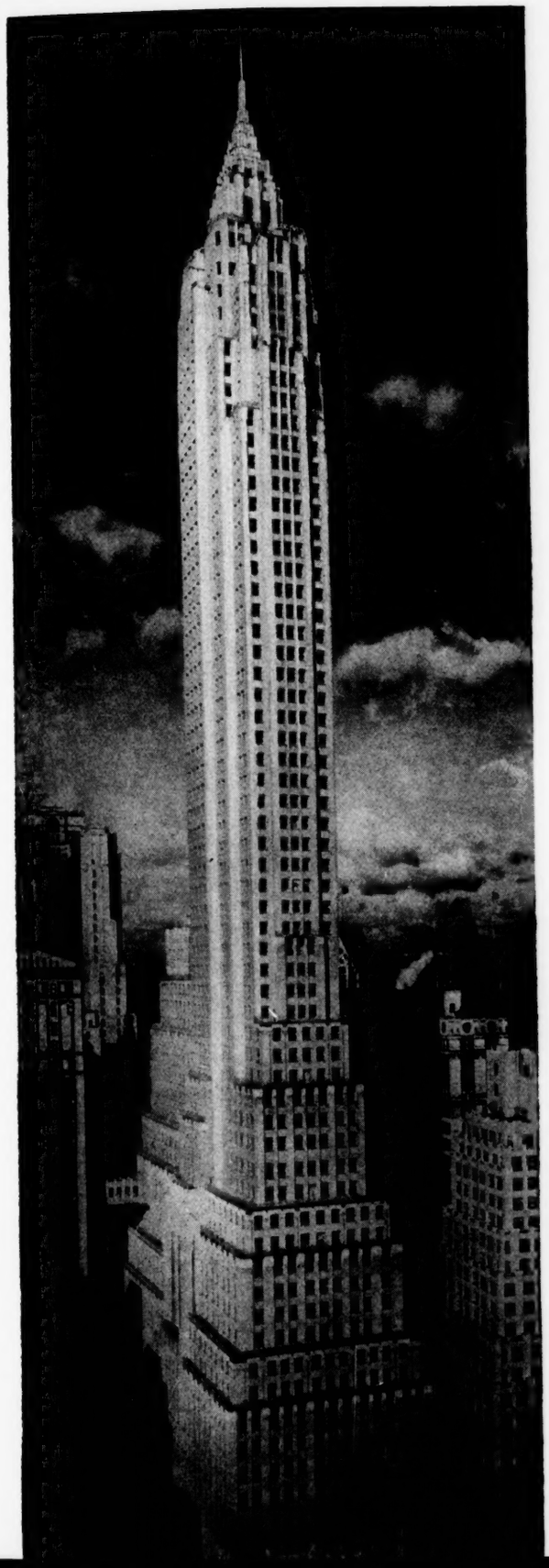
For water radiation, multiply the fuel consumption which is given for steam radiation by 5/8.

	New York	Seattle	San Francisco	Chicago	Denver	Boston	St. Louis	Pittsburgh	Minneapolis
Degree days	48	142	102	85	96	73	23	72	137
Lb. of coal per sq ft. of radiation for September	0.384	1.136	0.816	0.680	0.768	0.584	0.184	0.576	1.096
Gal. of oil per sq. ft. of radiation for September	0.033	0.097	0.070	0.058	0.066	0.050	0.016	0.049	0.094
Cu. ft. of gas per sq. ft. of radiation for September	4.61	13.63	9.79	8.16	9.22	7.01	2.21	6.91	13.15

	Los Angeles	Baltimore	Philadelphia	New Orleans	Atlanta	Cleveland	Cincinnati	Detroit
Degree days	.....	19	24	.....	14	65	56	83
Lb. of coal per sq. ft. of radiation for September	.. ..	0.152	0.192	.....	0.112	0.520	0.448	0.664
Gal. of oil per sq. ft. of radiation for September	.....	0.013	0.016	.....	0.010	0.045	0.038	0.057
Cu. ft. of gas per sq. ft. of radiation for September	.....	1.82	2.30	.....	1.34	6.24	5.38	7.97

	Buffalo	Birmingham	Indianapolis	Memphis	Des Moines	Kansas City	Louisville	Galveston
Degree days	116	.....	62	4	87	31	27	.....
Lb. of coal per sq. ft. of radiation for September	0.928	.....	0.496	0.032	0.696	0.248	0.216	.....
Gal. of oil per sq. ft. of radiation for September	0.080	.....	0.043	0.003	0.060	0.021	0.019	.....
Cu. ft. of gas per sq. ft. of radiation for September	11.14	.....	5.95	0.38	8.35	2.98	2.59	.....

Fuel consumption figures must be corrected for local conditions as explained above.



SIXTY WALL TOWER

HIGHEST IN DOWNTOWN NEW YORK, THIRD IN ALL THE WORLD

●

Architects: Clinton & Russell, Holton & George, *Heating & Ventilating Engineers:* Tenney & Ohmes, *General Contractor:* Jas. Stewart & Co., *Plumbing Contractor:* Jas. McCullagh, Inc., *Heating Contractor:* Riggs, Distler Company, Inc. *All of New York City*

NOT only in physical dimensions but in all that goes to make such a building admirable, "60 Wall Tower" stands high. Architects, engineers, and builders have given it dignity and soundness above the ordinary in design, construction, and equipment. In beauty, convenience, and outlook its occupants find much that is inspiring. Among its several advantages—superior transportation facilities and fine unobstructed views from successive set-back levels, etc.—the management directs attention to highly improved heating and ventilating for the health and comfort of the occupants. In the forced hot-water system by which the building is heated, it is worthy of mention that NATIONAL Pipe was used. Thus once again, signal recognition is accorded to NATIONAL—

America's Standard Wrought Pipe

NATIONAL TUBE COMPANY

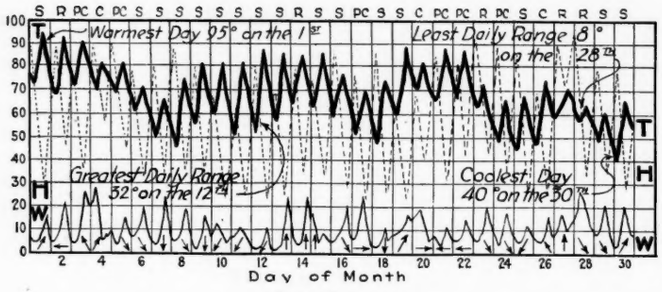
Subsidiary of United States Steel Corporation

PITTSBURGH, PA.

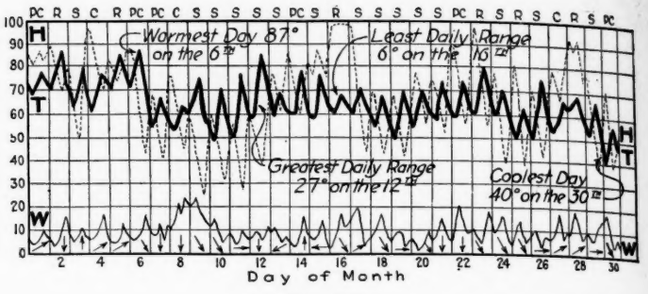
NATIONAL PIPE

The Weather

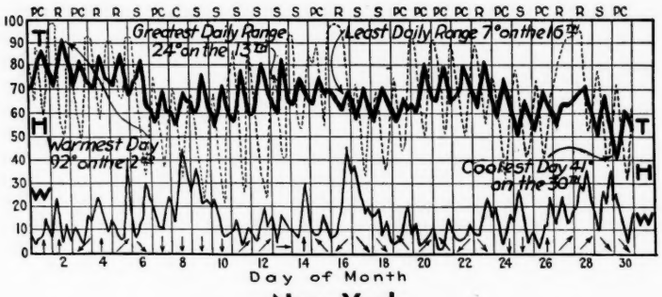
September, 1932


Warmest Day 95° on the 1st
Least Daily Range 8° on the 28th
Greatest Daily Range 32° on the 12th
Coolest Day 40° on the 30th
Day of Month

Pittsburgh

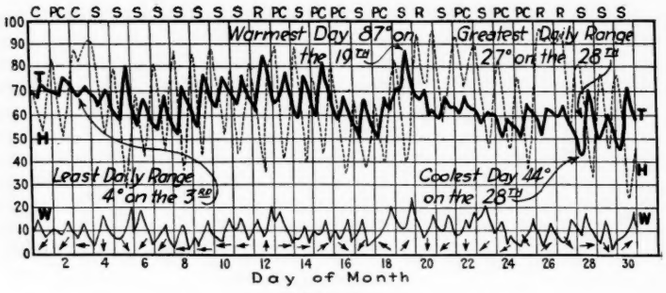

Warmest Day 87° on the 6th
Least Daily Range 6° on the 16th
Greatest Daily Range 27° on the 12th
Coolest Day 40° on the 30th
Day of Month

Boston

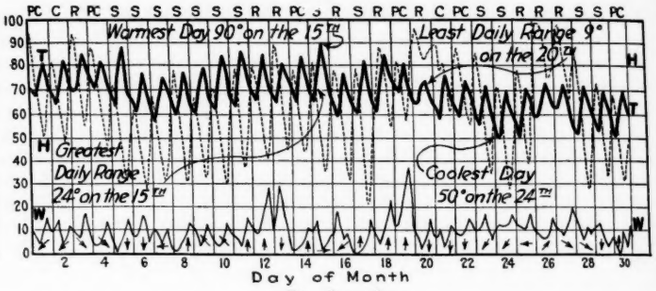

Greatest Daily Range 24° on the 13th
Least Daily Range 7° on the 16th
Warmest Day 92° on the 2nd
Coolest Day 41° on the 30th
Day of Month

New York

(Hourly observation of the Relative Humidity Plotted on this Chart)


Warmest Day 87° on the 19th
Greatest Daily Range 27° on the 28th
Least Daily Range 4° on the 3rd
Coolest Day 44° on the 28th
Day of Month

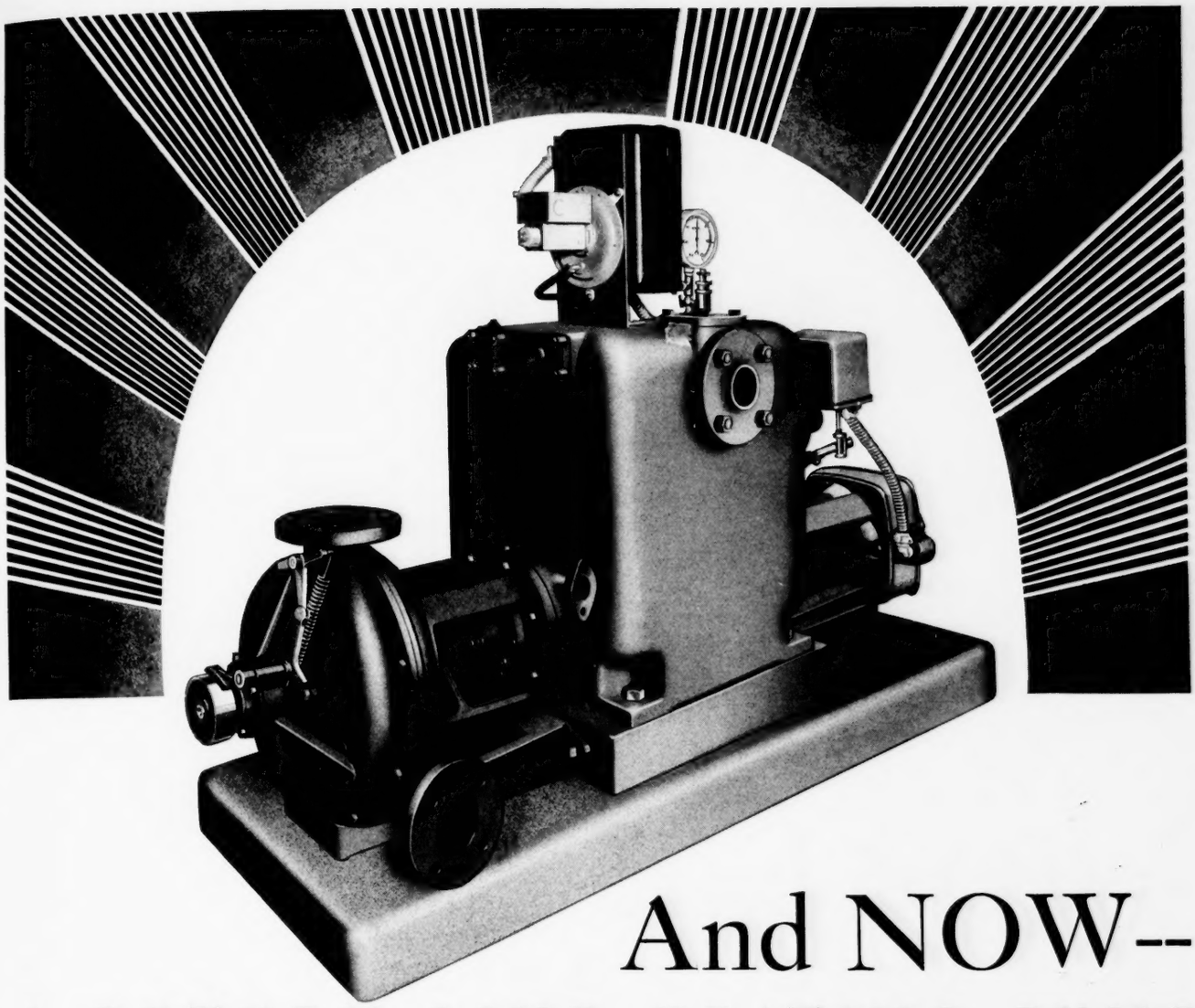
Chicago


Warmest Day 90° on the 15th
Least Daily Range 9° on the 20th
Greatest Daily Range 24° on the 15th
Coolest Day 50° on the 24th
Day of Month

St. Louis

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, deg. F.	92	87	95	87	90
Date of highest temperature	2	6	1	19	15
Lowest temperature, deg. F.	41	40	40	44	50
Date of lowest temperature	30	30	30	28	25
Greatest daily range, deg. F.	24	27	32	27	24
Date of greatest daily range	13	12	12	28	15
Least daily range, deg. F.	7	6	8	4	9
Date of least daily range	16	16	28	3	20
Mean temperature for month, deg. F.	67.7	65.2	67.8	64.4	69.6
Normal mean temperature for month, deg. F.	66.8	63.3	66.4	65.2	70.5
Total precipitation, this month, inches	1.56	4.50	0.59	1.12	2.15
Total snowfall, this month, inches	None	None	None	None	None
Normal precipitation, this month, inches	3.39	3.14	2.58	3.14	3.46
Total wind movement, this month, miles	9569	6269	6234	7088	6665
Average hourly wind velocity, miles	13.3	8.7	8.7	9.8	9.3
Prevailing direction of wind	N.	N.W.	N.W.	N.E.	N.
Number of clear days	11	15	10	15	16
Number of partly cloudy days	15	8	12	9	9
Number of cloudy days	4	7	8	6	5
Number of days with precipitation	8	6	8	5	10
Number of days with snowfall	None	None	None	None	None
Snow on ground, at end of month	None	None	None	None	None

Plotted from records especially compiled for HEATING AND VENTILATING by the United States Weather Bureau.
Heavy lines indicate temperatures in degrees F. Light lines indicate wind in miles per hou
Broken lines indicate humidity in percentage from readings at 8 a. m., 12 m., and 8 p. m.
S—clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow. Arrows fly with prevailing directions of win



And NOW--

A RETURN LINE HEATING PUMP OPERATING WITHOUT ELECTRIC CURRENT!

HERE IT IS! The Jennings Vapor Turbine Heating Pump. A New Pump. A pump meeting the modern demand for safety and economy in heating. It has all the advantages known to engineers throughout America as features of the standard Jennings Return Line Heating Pumps. Sturdy, fool-proof construction. Separation under vacuum. Air and water handled separately in pumping units designed for each. Balanced bronze impellers rotating without metallic contact on high grade ball bearings.

AND NOW, A NEW DRIVE. A Special vapor turbine, developed by the same engineers who made the Jennings Pump. It operates on steam directly from the heating mains and returns that steam to the heating system with practically no heat loss. Think of it!

A pump operating 24 hours a day, affording safety and economy which go with a continuous condensation return and steady vacuum, and at no cost for electric current! The biggest expense item has been eliminated and operating efficiency increased! It operates on any vacuum heating system.

Every item has been considered adding utility to this pump. It is equipped with a complete electrically operated stand-by unit that will automatically operate should the turbine be cut out for inspection or servicing. This stand-by unit also gives full automatic electric operation, if it is desired.

Prices are in harmony with the times. Write for Bulletin No. 203 describing this remarkable pump.

Jennings Pumps

NASH ENGINEERING COMPANY, SOUTH NORWALK, CONN.

It's hard for a Hungry citizen

to be a *Good* CITIZEN

THE boy whose stomach is empty cannot be expected to do good work at school. Babies undernourished through another winter may be handicapped by frail bodies through life. The hungry father of a family is hardly the man to seek employment with persistence, or to do well on the job when he gets it.

Before you can save a man's soul it is often necessary to feed his body. You have no right to expect the civic virtues of patience, courage and honesty from starving, freezing men and women. If they preserve a just attitude towards the laws of the city in which they live, it is a miracle.

This winter, as never before, it is the duty of all who are well-clad, well-housed, and well-fed to help the less fortunate. The fact that you gave last year, and the year before, does not lessen your responsibility. The fact that you cannot afford a large contribution must not deter you. The upturn of business with a gradual improvement of economic conditions does not remove the crisis of this moment. Emergency appropriations by the federal government amount to $300,000,000, but they meet only half the increased national needs for human relief.

The rest is up to you!

How will your dollars be used? First of all, they will feed the hungry, and relieve the absolute want of the unemployed.

They will be used, also, to take care of the sick and aged. They will help to maintain hospitals, orphanages and schools. They will make possible clinics and visiting nurses.

The dollars you give are invested in the forces of civilization right in your community!

WELFARE AND RELIEF MOBILIZATION, 1932

The Welfare and relief Mobilization for 1932 is a cooperative national program to reinforce local fund-raising for human welfare and relief needs. No national fund is being raised; each community is making provisions for its own people; each community will have full control of the money it obtains.

Give through your established welfare and relief organizations, through your community chest, or through your local emergency relief committee.

Newton D. Baker, Chairman, National Citizens' Committee

This winter, as never before, support your local Community Campaign

Heating and Ventilating

45 years of timely service

For 45 years Webster has been working with the Heating Industry — helping to successfully meet the problems and opportunities of changing times.

In 1888 Webster pioneered in the development of the Vacuum System of Steam Heating—replaced crude efforts with positive, ample heat; turned wasted exhaust steam to the service of industry.

During the recent era of expansion, Webster service to architects, engineers, heating contractors and building owners assured correct application and *maintained* quality.

Webster long foresaw the need for an augmented *service in modernization*. New and improved products were developed. In 1931-32 Webster offered a *complete program* for modernization.

Webster enters 1933 prepared in product, plant, personnel and financial strength to meet the problems and opportunities of the New Year.

WARREN WEBSTER & CO., Camden, New Jersey
Pioneers of the Vacuum System of Steam Heating
60 Branch Offices—In Canada, Darling Bros., Ltd., Montreal

-since 1888

Webster

Systems of Steam Heating